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EMPIRE MARKETING BOARD

MAY 1932 to MAY 1933



JUNE 1933

LONDON

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PREFACE

THE EMPIRE MARKETING BOARD IN 1932-33

FOR the last four years the Empire Marketing Board has been able to announce in its Annual Report new records of shipments of a variety of Empire products to the United Kingdom. It is satisfactory again to be able to report, notwithstanding the difficult times through which we have recently passed, that this progress has continued during the year under review.

The following table gives the volume of imports of twenty-four products into the United Kingdom from Empire sources which established new records during 1932:—

Commodity.	Country of Origin.	Quantity in 1932.	Previous Record.
		Total.	
Wheat	Australia ..	24,159,000 cwts.	23,300,000 cwts. in 1931
	Canada ..	46,874,000 "	41,005,000 " " 1928
Wheat flour	Australia ..	2,830,000 "	2,558,000 " " 1931
Frozen lamb	New Zealand ..	8,454,000 carcasses	8,168,000 carcasses " 1931
	New Zealand ..	2,190,000 cwts.	1,925,000 cwts. " 1931
Butter	Australia ..	1,829,000 "	1,558,000 " " 1931
	Australia ..	15,147,000 dozen	9,182,000 dozen " 1931
Eggs ..	Australia ..	15,147,000 dozen	9,182,000 dozen " 1931
Tea ..	Ceylon ..	172,000,000 lbs.	159,000,000 lbs. " 1931
Canned pine-apple.	B. Malaya ..	911,000 cwts.	676,000 cwts. " 1931
Tobacco	Canada ..	10,844,000 lbs.	6,273,000 lbs. " 1931
	Nyasaland ..	15,064,000 "	13,781,000 " " 1927
	S. Rhodesia ..	10,452,000 "	10,280,000 " " 1928
Bananas ..	B.W. Indies ..	10,609,000 bunches	6,971,000 bunches " 1931
Apples	Australia ..	1,684,000 cwts.	1,442,000 cwts. " 1928
	New Zealand ..	573,000 "	380,000 " " 1930
Oranges ..	Palestine ..	1,639,000 "	1,359,000 " " 1927
	South Africa ..	75,000 "	65,500 " " 1931
Grapefruit	Palestine ..	81,000 "	35,500 " " 1931
	B.W. Indies ..	72,000 "	41,000 " " 1929
	South Africa ..	32,000 "	29,000 " " 1931
Plums	Canada ..	20,000 "	18,000 " " 1928
Grapes ..	South Africa ..	68,000 "	59,000 " " 1931
Peaches ..	South Africa ..	30,000 "	25,700 " " 1930
Pears ..	New Zealand ..	40,000 "	19,500 " " 1931

Some of these records are sufficiently striking to deserve comment. Not only did imports of wheat from Canada constitute a record for supplies coming to the United Kingdom from that country, but the 1932 total has never been exceeded by any country except during the two war years, 1916 and 1917, when imports from the United States of America reached a higher figure. Imports of eggs from Australia, bananas from the British West Indies, tobacco from Canada, apples and pears from New Zealand, and grapefruit from Palestine and the British West Indies all exceeded by 50 per cent. or more their previous best. Besides the record importation of Canadian tobacco, it is noticeable that imports from both Southern Rhodesia and Nyasaland established new records, exceeding the quantities imported in 1928 and 1927 respectively; in those years the heavy imports led to large accumulations of stocks in the United Kingdom, but no similar accumulation has resulted from the record imports of 1932.

In addition to the products mentioned in the table, attention should also be drawn to apples from South Africa, oranges from Cyprus and grapefruit from British Honduras. These as yet constitute only a small fraction of the United Kingdom annual supplies, but in each case the 1932 imports were on a higher level than in any earlier year.

South African butter and eggs and Australian frozen lamb failed to reach the 1931 level, but imports were larger than in any other year. Imports of South African oranges fell short by only 20,000 cwts. of the record imports in 1930. Imports of tea from India, at 312 million lbs., were greater than in any year since 1918, and imports of Australian rabbits, totalling 574,000 cwts., were the largest since 1916. A welcome improvement in imports of rice from India brought the total to over 1,000,000 cwts. for the first time since 1925.

Neither Australian nor South African wine quite reached the highest figures previously recorded—in 1927 for the former and in 1931 for South Africa; but clearances for home consumption established new high records and it is evident that Empire wines are continuing to strengthen their position in the United Kingdom market.

No new individual records in sugar imports were established in 1932, but the total of over 14 million cwts. from all Empire countries combined was the largest ever recorded. Imports from Australia

and South Africa failed to reach their 1931 record levels, but there was an increase in supplies coming from Mauritius, while imports from the British West Indies (including British Guiana and British Honduras) totalled nearly 4,000,000 cwts. and were the highest for over 50 years.

THE OTTAWA CONFERENCE AND THE EMPIRE MARKETING BOARD

The future of the Board's work was discussed at the Ottawa Conference* in 1932, when it was recommended that a Committee should be appointed forthwith, consisting of not more than two representatives of each of the participating Governments, to consider the means of facilitating economic consultation and co-operation between the several Governments of the Commonwealth, including a survey of the functions, organisation and financial bases of certain specified agencies, and an examination of what alterations or modifications, if any, in the existing machinery for such co-operation within the Commonwealth were desirable.

The Conference further recommended that it should be an instruction to the Committee to elect their own Chairman from among their members, and to report to the several Governments represented thereon not later than the 31st May, 1933, with a view to the consideration of their report by the several Governments not later than the following September.

The United Kingdom delegates to the Conference stated that, in order that the necessary time might be available for the preparation and consideration of the report of the Committee, the Government of the United Kingdom would continue to furnish any funds which might be required to finance essential work of the Empire Marketing Board down to the end of September, 1933. The Conference recorded its deep appreciation of the action of the United Kingdom in this respect.

The Committee which was appointed, upon the invitation of the Government of Canada, as a result of the recommendation of the Ottawa Conference, met in London during the early months of 1933 and signed its report just before Easter. Its recommendations had not been published at the time of printing this Annual Report.

* See "Imperial Economic Conference at Ottawa, 1932. Summary of Proceedings." H.M. Stationery Office. Cmd. 4174 (1s. 6d. net).

FINANCE

Following the issue of the report of the Committee on National Expenditure in 1931, the Government decided that it would be necessary to limit the Board's net Vote for the year 1932-33, to £300,000. In consequence, the work of the Board during the year under review has had to be restricted almost entirely to the maintenance and consolidation of pre-existing activities.

RESEARCH

Last year's report gave an account of the action taken by the Board to give effect to the recommendation of the Imperial Conference of 1930 in regard to the planning of joint programmes of research on a broad Empire basis. Further replies have been received during the year to the Board's letter of March, 1931. A significant feature of these and previous replies is the striking measure of agreement among the Empire's scientific authorities as to the problems most urgently requiring further research in the general economic interests of the Empire.

The most promising development in the research activities of the Board during the past year has been its part in the initiation of a programme of parasitological research at the newly established Institute of Helminthology at Macdonald College in Montreal. The Institute has started its work under a special Associate Committee on Parasitology of the National Research Council of Canada and a Director appointed from Scotland.

As will be seen from the research section which follows, good progress continues to be maintained in the many fields of research covered by the Board's grants.

STATISTICAL SURVEYS AND MARKET INTELLIGENCE

Financial considerations during the past year have prevented that extension of the Board's work in the direction of market intelligence and statistical surveys which was envisaged by the Imperial Conference of 1930, but there has been at any rate no curtailment of these activities. Throughout the year the weekly market intelligence services have been maintained for fresh fruit, canned and dried fruits, dairy produce and pig products. Enquiries have been prosecuted among retailers into regional preferences and changing

demand for Empire foodstuffs. Further experimental consignments have been handled of fruits and vegetables for which Empire growers hope to develop a market in the United Kingdom. The series of brief statistical pamphlets on the production and trade of the countries of the Empire has been completed, and the series dealing on somewhat similar lines with groups of commodities has been continued. Progress has been made with statistical world surveys of individual agricultural products; and three reports, on oil palm products, coconut palm products and wool, have been issued during the year.

At the suggestion of the Board's Wool Statistics Advisory Committee, the Board has made concrete proposals to the Governments of the Empire, to the International Institute of Agriculture and to the International Wool Textile Organisation for the improvement and better co-ordination of international wool statistics.

MARKET PROMOTION

The work of the Marketing Branch of the Board, with its team of four Marketing Officers, has continued to develop, particularly in its approach to large consumers, such as Local Authorities, hotels, shipping companies, etc., with a view to guiding their purchases into Empire channels. It has been possible to enlist the sympathetic co-operation of the organisations approached, and supplies from Empire sources not only of foodstuffs and tobacco, but also of such articles as glassware, hospital equipment and school furniture are now being specified in an ever increasing number of tender forms as the result of this branch of the Board's work.

Similarly the Food Products Committee, whose members include men well versed in problems associated with the various branches of the food trades, have extended the scope of their work during the year under review. The results of their investigations into the market conditions in this country of a large number of Empire commodities have been made available to the producers or packers concerned.

PUBLICITY

No marked development or extension of the Board's publicity activities has been possible during the past year. Following the rigorous curtailment of the Board's finances, provision was made for the continuance during the year 1932-33 of existing publicity work on a care and maintenance basis only.

Encouraged by the experience gained at the Empire Shops opened previously in a number of provincial towns, the Board made special provision for the leasing of two further Shops during the year. From May to September, 1932, a Shop was opened in Sheffield; and from September, 1932, to February, 1933, another was opened in Cardiff. In both instances it was again demonstrated that this particular form of publicity was singularly suited to the Board's purposes. It is also interesting to note that the sales of samples of Empire products at the six Shops which the Board has opened have now exceeded one million.

In continuation of its work in connection with the marketing of Empire Timbers, the Board, in the Summer of 1932, published a "Handbook of Empire Timbers". This work, which was compiled with the assistance of the Forest Products Research Laboratory, the Royal Botanical Gardens, Kew, and the Imperial Institute deals with a wide range of the timbers which are produced in different parts of the Empire and which are commercially obtainable in the United Kingdom. In conjunction with the "Buy British" Committee of the Forum Club, and with the Building Centre in New Bond Street, exhibitions of Empire Timber, and articles made therefrom, have been staged. Both of these efforts, which have been made possible by the generosity and whole-hearted co-operation of the bodies concerned, have helped considerably to bring Empire timbers to the notice of potential users.

The Board's Film Unit has continued the production of films for both theatrical and non-theatrical display, and in addition has undertaken the production of a number of films for other Government Departments.

A group of the Board's films in silent form has been sold for a substantial sum to a commercial company, for subsequent synchronisation and distribution in public cinemas. For school use and other non-theatrical displays 43 films have been prepared and added to the Board's Film Library. In addition the Library has been appreciably strengthened by the addition of films generously placed at the Board's disposal by Dominion Governments, the Canadian National Railways and other organisations. The number of schools and other bodies making use of the Library has nearly doubled since the previous year. So rapid, indeed, has been the development of this type of distribution that, although the number of prints of films

available has been more than trebled, considerable difficulty has been experienced in meeting the demand. During the course of the year displays of the Board's films have been given to audiences totalling over 1,000,000 people.

CHANGES IN MEMBERSHIP

Few changes in the membership of the Board have occurred during the past years. Major Elliot, on his appointment as Minister of Agriculture, was succeeded by Mr. Hore-Belisha. Sir Robert Hamilton, on his retirement from office, was succeeded by Lord Plymouth. More recently, Mr. W. A. Wilson, who had been a member of the Board from its first establishment, retired from the Board, in view of the pressure of his other duties, and was succeeded by Mr. Harrison Watson, the Chief Canadian Trade Commissioner in the United Kingdom.

The Board suffered a heavy loss in May, 1933, by the death of Mr. J. C. Stobart, Director of Education of the British Broadcasting Corporation, who had been a member of the Publicity Committee since its formation.

Mr. Gervas Huxley, who had been Secretary of the Publicity Committee since 1926, left the Board's service in December, 1932, upon his appointment as Commissioner of the Ceylon Tea Propaganda Board.

I. GRANTS FOR RESEARCH AND DEVELOPMENT*

A further close scrutiny of research commitments and expenditure has been rendered necessary during the year in the light of the new position, reported in the Preface, which confronted the Board after the Ottawa Conference. A special Committee was appointed by the Secretary of State for Dominion Affairs to examine the Board's expenditure and to consider the financial provision necessary for preserving essential services on a limited though efficient basis. In the field of research, as indeed in every other field of activity, the circumstances have dictated a restricted programme of maintenance and the postponement or withholding of support from any new and promising research activities which have been brought to the Board's notice.

THE PLANNING OF JOINT PROGRAMMES OF RESEARCH

Since last year's Report was issued further replies have been received from the Imperial Council of Agricultural Research for India and the Colonial Advisory Council of Agriculture and Animal Health to the letter addressed by the Board in March, 1931, to oversea research organisations as the outcome of the discussions which took place at the time of the Imperial Conference of 1930. Summaries of replies previously received from Australia, the Union of South Africa and Southern Rhodesia were given in last year's Report, and the following are summaries of the replies now received from India and the Colonial Advisory Council of Agriculture and Animal Health.

Imperial Council of Agricultural Research for India

The major problems suggested by the Council as requiring further research in the general economic interests of the Empire cover the fields of low temperature research, animal nutrition, animal health and helminthology, wool research, entomology, plant breeding and plant pathology. The special lines of further research suggested relate to (i) fruit transport problems and the effect of storage on fruit; (ii) mineral deficiencies in the food of livestock; (iii) the

* Provision was made in the printed Estimates for 1932-33 for an expenditure on research of £296,620.

feeding qualities of Indian millets for livestock, especially poultry ; (iv) tuberculosis and John's diseases of cattle, contagious abortion and sterility, the control of entozoal parasites of domestic animals, the special diseases of poultry, foot-and-mouth disease, the differentiation of various protozoal organisms, such as various forms of Theileria and Piroplasma, Trypanosomes and Coccidia and their control ; (v) wool research problems ; (vi) the biological control of insect pests by the breeding of beneficial parasites ; (vii) virus diseases of plants especially mosaic diseases of sugar cane and virus diseases of potatoes ; (viii) cotton breeding ; and (ix) the genetics and cytology of sugar cane. Further subjects suggested relate to the water requirement of crops under irrigation conditions, research on oil-seeds, investigation into the causes of fertility in soils, and the development of agricultural meteorology.

Colonial Advisory Council of Agriculture and Animal Health

In the field of animal health the Colonial Advisory Council of Agriculture and Animal Health recommends the development of research (i) on bovine sterility, including infection due to contagious abortion and sterility arising from nutritional and other physiological causes ; (ii) on Redwater and Anaplasmosis, including a study of the parasites concerned ; (iii) on Theileriasis, covering (a) the species of Theileria concerned and their geographical distribution, (b) the immunity conferred by each species on any other and (c) the immunity conferred by a species on itself ; and (iv) on the prevention and treatment of Helminthiasis. On the nutritional side research into the mineral and vitamin requirements of cattle and sheep with special reference to the relationship of these deficiencies to disease is recommended, and on the genetical side experimental work is suggested with a view to securing data in regard to the physical and economic attributes of indigenous species of stock already existing in the Colonies with a view to their standardisation and improvement. Attention is drawn to the need for investigation into the prevalence and nature of those diseases of the skin which reduce the economic value of hides and skins produced in the Colonies. In the agricultural field the Council recommends further research on virus diseases of tropical crops, on vegetative propagation under tropical conditions and on Witchbroom disease of cacao. Comprehensive research, including botanical, chemical and cytological investigation, is required in connection with the oil palm and coconut

industries, as well as research on the production side of the sisal and coffee industries within the Colonial Empire. Plants possessing insecticidal properties should be studied, and further research into the general methods of field experimentation, including the lay-out of field experiments, the working up of results and their interpretation, is still needed.

The five replies, read together, indicate a wide measure of agreement in regard to the subjects most urgently requiring further research in the general economic interests of the Empire ; and they provide a useful and authoritative basis for the planning of joint programmes of research to which, if financial conditions permitted, the Board would have been ready to lend its assistance. It is interesting to note that most of the fields of research mentioned in the replies have been to some extent covered by grants made from the Empire Marketing Fund.

BIOLOGICAL AND AGRICULTURAL SCIENCES

Development of Biological and Agricultural Departments of the University of Cambridge

The Board's third instalment of £10,000 in aid of the scheme for the development of the Biological and Agricultural Departments agreed between the University of Cambridge and the International Education Board of the Rockefeller Foundation was paid in March of this year.

Work on the construction of the new Library started in October and the building is expected to be completed by April, 1934. A site for an Entomological Field Station was provided on the University Farm and the building of the laboratory and insect houses is nearing completion. The extension to the School of Agriculture has been completed.

FOOD PRESERVATION AND LOW TEMPERATURE RESEARCH

The Board has continued to support, during the year 1932-33, low temperature research at Cambridge and at the Ditton Laboratory, East Malling, and research into the preservation and transport of fish at Aberdeen. A further grant has been approved in support of this work till September, 1933.

Cambridge Low Temperature Research Station

Meat.—Work is being developed along five main lines: (i) the state of the water in tissues; (ii) the changes in the state of the proteins during *rigor* and storage; (iii) spoilage due to the action of micro-organisms; (iv) chemical changes in fats; and (v) the changes in muscle pigments *post mortem*. During the past year, knowledge obtained in each of these fields of work has been of immediate value in attacking a number of applied problems.

Attention has been given particularly to the possibilities of extending the life of chilled beef by storing it in atmospheres containing carbon dioxide, and the various aspects of the problem have been dealt with in a series of papers published in the *Journal of the Society of Chemical Industry*. Broadly speaking, the laboratory experiments indicate that in 10 or 20 per cent. carbon dioxide the storage-life of the meat is about doubled. A report has also been written on the storage of meat in small refrigerators. The most striking conclusion is the importance of clean handling if the maximum storage-life is to be realised. Other problems under examination include rapid freezing, the changes during the storage of frozen meat, the storage of poultry in carbon dioxide and the ideal wrapping for foodstuffs rich in fat.

Fruit and Vegetables.—Ethylene gas has been found to retard the sprouting of potatoes, and field-trials are in progress to test whether this discovery can be applied to stopping the sprouting of potatoes stored in clamps during the spring. The effect of ethylene upon the carbohydrate-metabolism and respiration has been further explored.

The volatile substances given off by ripe apples have been found to affect potatoes in the same way as ethylene gas. They have also been found to have other remarkable effects, i.e. retarding and inhibiting the germination and growth of seeds, accelerating the ripening of apples by inducing an earlier climacteric, accelerating the ripening of tomatoes and bananas and the germination of fungal spores in water. In these effects they simulate ethylene gas.

Scald in apples, of critical importance in gas-storage, is also considered to be related to the accumulation of volatile substances given off by ripening fruit. Scald can be controlled by the presence near the fruit of mineral oils. Experimental analysis has shown

that the amount, proximity and surface of oil (usually carried on apple-wrappers) are of critical importance. Other experiments have brought to light a hitherto unrecognised factor, i.e. that scald is related to the rate at which the fruit loses water. Other things being equal, more scald occurs under conditions of high humidity.

The continued study of the action of volatile substances and gases upon the growth of mould-producing fungi has shown that no simple classification of inhibitors by their action is at present possible. The use of regulated amounts of ammonia gas in the atmosphere for controlling rotting of fruits has given satisfactory results in the laboratory. Large-scale trials have been made during the year with tomatoes and oranges which have brought to light difficulties in commercial application. These are being investigated.

The respiration, heat-production and gas-storage of bananas have been studied, and a new method of regulating the gas-content of the storage atmosphere has been worked out and tested on a small scale. By this method, utilising the respiratory activity of the fruit, low oxygen with *low* carbon dioxide can be obtained, i.e. the conditions most suitable for bananas.

The study of respiration and of chemical changes in cold-stored apples and potatoes has been carried further. There appears to accumulate at low temperatures an "inhibitor" which affects respiration and may be closely related to the cause of low-temperature breakdown, which is the most serious general limiting factor in cold-storage practice.

In co-operation with the New Zealand Department of Scientific and Industrial Research, investigations have shown that a large range of varieties of apples investigated after transport will tolerate temperatures as low as 28° F. and carbon dioxide up to 10 per cent. for long periods without injury. The effect of transport upon quality and wastage is being studied by the method of experimental shipments.

The study of changes occurring in fruit preserved in a frozen state occupies considerable attention. Apples frozen and stored in air at - 5° C. lose vitamin C quickly. To preserve the vitamins in the presence of oxygen, temperatures below - 15° C. must be used. The results of a series of practical trials in storage of various fruits and vegetables at freezing temperatures have been published.

Pork, Bacon and Hams.—Since practically all our imported bacon is tank-cured, it has been suggested that it might be advisable for the home industry to adopt the tank-cure instead of the more usual dry-salt cure. A comparison of the two methods has, therefore, been carried out. Two hundred sides of bacon were followed through the processes; and on the average the tank-cured sides weighed 3 per cent. more than the dry-salt cured sides before being smoked and 2 per cent. after being smoked. As regards taste, the dry-salt cured bacon was preferable, being less salt and somewhat better flavoured.

Previous work has shown that mild-cured bacon cannot be kept successfully for long periods in the frozen condition because the fat tends to become rancid after defrosting. On the other hand, if the bacon is stored at temperatures above 0° C. (32° F.) it tends to suffer from spoilage caused by the superficial growth of micro-organisms. Curiously enough, the growth of micro-organisms actually prevents the development of rancidity. Smoking retards the growth of micro-organisms and the development of rancidity, and thus increases the storage-life to such an extent that smoked mild-cured bacon could be transported from Australia and New Zealand. Unfortunately, the wholesale trade in this country is almost entirely confined to *unsmoked* bacon while smoking must be carried out in this country because the "bloom" of smoked bacon is rapidly lost.

Unsmoked mild-cured bacon cannot be successfully transported from New Zealand or Australia by ordinary commercial methods. On the laboratory scale, however, the problem of prolonged storage has been solved by the use of atmospheres of carbon dioxide. Whole sides of bacon have been stored in special gas-tight containers for as long as 18½ weeks at 32° F. without showing any signs of rancidity or spoilage caused by micro-organisms. Encouraging results have also been obtained with pork stored in the same way. Further experiments are in progress.

Biological Engineering.—In the section on biological engineering, work is being continued on the factors governing evaporation of water from fruits in cold storage; the relation of rate of evaporation to temperature and humidity has been rather fully worked out in the case of the Bramley's Seedling apple and the banana. The exchange of water between pulp and peel in the ripening of the banana has also been investigated.

The evaporation data, together with measurements which have simultaneously been made of the rate of heat-production, have been used to calculate the humidity-equilibria in stacks of fruit in the holds of ships and elsewhere.

Investigations have been commenced on the water relations of grain and other seeds, and a study has been made of the nature and effects of the volatile substance given off by ripe apples which so markedly affects the germination and growth of certain seedlings.

Canning.—The effect of citric acid on a considerable number of the metals used in factory equipment has been studied, together with the effect of their soluble salts on the red and purple colours of fruits. It is unfortunate that the metals of tinfoil alone affected these colours adversely when present in quantities likely to be met with in fruit products.

Evidence from practical tests is now available to show that the inhibitor present in beet-sugar has an appreciable effect in reducing the numbers of hydrogen-swells with canned fruit over a given period. The inhibitor appears to be most effective with products of moderately high acidity.

Results of practical interest have also been obtained in connection with the cooling of cans. Prolonged cooling in water has been shown to increase losses through fermentation, even with cans which have passed the usual tests for leaks.

Experiments on the concentration and storage of orange-juice by freezing have shown that it is possible to obtain a product of excellent colour and flavour. The presence of pectic compounds, however, may cause the formation of a gel of pectic acid on standing at ordinary temperature. Freezing experiments with fruits and vegetables have confirmed and extended previous results, and have shown the possibility of establishing a new industry for frozen products.

Torry Research Station, Aberdeen

At this Research Station various problems connected with the preservation, handling and utilisation of fish are being investigated.

The application of brine-freezing and low-temperature storage to long-distance steam-trawlers (referred to in previous reports) has

developed on practical lines, and designs, specifications and estimates of cost for plant suitable for several types of fishing vessels have been prepared for the information of the industry.

The research on smoke-curing has also led to the investigation of design, and practical proposals have been made for the improvement of both kilns and methods.

The study of the fats and oils of fish has been continued and extended. Besides information of medical and pharmacological value, these investigations tend to a greater understanding of the industrial possibilities of various types of fish oil.

An active extract has been prepared from livers of fish for the treatment of pernicious anaemia. As the outcome of the work, the production of this extract has been taken up commercially.

The sub-freezing temperature at which the rate of *post-mortem* breakdown of carbohydrate in fish muscle is at the maximum has now been ascertained.

The bacteriology of fish is being closely studied. The principal flora associated with spoilage of ordinary white fish have now been identified. Observations on the bacterial or inhibitive effect of carbon dioxide have also been made.

Ditton Laboratory

Biological Engineering.—The second season's observations in the experimental hold were mostly devoted to a study of the grid-system of refrigeration from the point of view of the distribution of temperature inside the stack of fruit and of the factors governing the transfer of heat from fruit to air and from air to cooling pipes. The phenomena of heat-transfer were also studied in some detail during the summer months in the empty hold, and the results were of interest as providing evidence of the mutual screening effect of adjacent pipes, which has an important bearing on the question of the optimal pipe-density. Measurements of the biological constants—heat-production, evaporation and gaseous exchange of the stack—have been continued. The biological importance of small inequalities of temperature inside the stack were further emphasised by a detailed examination of the condition of the fruit at the time of discharge.

Fruit and Vegetables.—A second series of experiments on the gas-storage of English apples is in progress. The varieties under trial are Monarch, Blenheim Orange, Worcester Pearmain and Cox's Orange Pippin. The gas-mixtures and temperatures are, with one exception, the same as those used last season. Samples of fruit are being gas-stored after various periods of storage in air (during which their respiratory activity is being followed) in order to determine whether susceptibility to injury from high concentrations of carbon dioxide is related to the maturity of the fruit when it is placed in gas-storage.

The uninsulated store with automatically controlled refrigeration was successfully operated with a full load of fruit, with economic results which seem to justify the further commercial exploitation of this system in simple orchard cold-stores.

Imperial College of Tropical Agriculture, Trinidad

A conference to discuss the continuance of the work on the transport and storage of bananas and other tropical fruits at the Imperial College of Tropical Agriculture was convened by the Board in July. This was attended by the Principal and Secretary of the College, the Plant Pathologist, and representatives of the Royal Botanic Gardens, Kew, the Imperial Mycological Institute, the Cambridge Low Temperature Research Station, the Colonial Office and the Board. On the recommendation of this conference the Board has approved a further grant for continuing the work during the first half of the current financial year.

A considerable demand has arisen for work on vegetable products grown in the tropics in addition to bananas; the main reason for this is the development of trade between Canada and the West Indies, fostered by a direct shipping line. In the past two years large supplies of West Indian tomatoes have found a market in Canada and this development has led the College to study the question of transporting tomatoes for journeys of about 14 or 15 days. A report on this work has been published by the Board.* Other problems concern the transport of mangoes, avocados, grape-fruit and oranges grown in the wet tropics. The College is receiving valuable help from the Cambridge Low Temperature Research Station.

* "The Storage of Tropicallly Grown Tomatoes," by Claude W. Wardlaw and Laurence P. McGuire. E.M.B. 59, published by H.M. Stationery Office (price 1s.).

Reference was made in last year's Report to the value of the Trinidad work on bananas to New Zealand in connection with the transport of bananas from Samoa. A number of transport difficulties have arisen in shipping bananas from Samoa to New Zealand and, as a result of correspondence between the Secretary of the New Zealand Department of Scientific and Industrial Research and the Principal of the Trinidad College, arrangements have been made for the banana experts to carry out storage trials in an effort to solve the difficulties. The published results of the Trinidad work have also been of value in Australia where co-operative investigations into the ripening and transport of bananas have recently been undertaken.

A further report on the control of wastage in bananas has been published during the year.*

ANIMAL HUSBANDRY

Research on the Mineral Content of Natural Pastures

The work on the mineral content of pastures during the year has been, for the most part, a continuation and extension of the work of the previous years, with the main effort, as before, directed to the application in practice of results previously obtained in research.

In Scotland the investigation of the influence of deficiencies in pasture on the incidence of disease has been continued along the lines previously indicated. Further data have been obtained from large groups of sheep kept under natural conditions and from experimental groups housed under uniform conditions and kept under close observation with a view to checking any correlation between the composition of the pastures, the chemical composition of the blood, the immunological reaction of the blood and the susceptibility to disease. This work has been extended by the inclusion of balance experiments designed to determine (i) the mineral requirements of breeding ewes at different periods during the annual cycle, and (ii) the most suitable form in which to supply certain mineral supplements. Some of this work has been described recently by Dr. Orr and Dr. Fraser (Trans. Highland and Agric. Soc., 1932).

* "Control of Wastage in Bananas, with special reference to Time and Temperature Factors," by Claude W. Wardlaw and Laurence P. McGuire. E.M.B. 60, published by H.M. Stationery Office (price 1s.).

In Australia, at the Waite Institute, University of Adelaide, interesting results, from the point of view of pasture management in arid regions, have been obtained in a study of the factors affecting yield and composition of a perennial grass, *Phalaris tuberosa*. The total nitrogen, phosphate and potash contents of the dried herbage, which were very high in the early stages of growth, fell steadily to a minimum at the mature stage. In the case of the nitrogen and phosphate this was due to downward migration to the basal internodes and root system, but for potash there was a substantial and actual loss (27·8 per cent. of the total intake) which must be regarded as a migration from the plant to the soil. No loss of lime or soda occurred either from the herbage or the entire plant. The yield of nutrients per litre of water transpired was greatly increased by severity of cutting, the high increases of nitrogen and phosphate thus obtained being significant in areas of low and uncertain rainfall. Taking into account the permanence of the plant in an arid region, the yields of dry matter and nutrients, and the conservation of water in relation to nutrients, a system of three cuts per annum applied to this grass would probably give optimum results.

In New Zealand, under the direction of the Department of Agriculture and the Department of Scientific and Industrial Research, considerable further attention has been paid to the iron problem in relation to "bush-sickness." A wide range of plant specimens has been analysed for iron content and the results correlated with the available iron in the soil. The soils, from localities definitely associated with bush-sickness, gave comparatively low figures for available iron. As a result of work on non-volcanic soils and their pastures, however, it is pointed out that it does not necessarily follow that a low iron content of the soil is itself responsible for the appearance of bush-sickness. The results of certain pot experiments show that plants have no difficulty in obtaining a supply of iron for their tissues and that fertiliser treatment has little effect so far as the percentage of iron is concerned. Crop weight is likely to be affected by deficiency of iron in the soil more than is the percentage of iron contained in the crop. Attention has been drawn to the use of limonite as a source of iron for feeding to stock and it has been found to be quite as satisfactory as iron and ammonium citrate. It can be made up as a lick with salt and is less costly.

Work has been started on factors influencing the organic and inorganic sulphur content of mixed pasture and certain individual

species. The percentage of both forms of sulphur tends to be higher in the plant during periods of rapid growth. Ryegrass is richer than clover in total and inorganic sulphur but clover has a higher content of organic sulphur.

In connection with an investigation on bovine eclampsia analysis of pasture samples from affected and unaffected farms in one area showed no difference with reference to nitrogen, calcium or phosphorus content, nor in the amounts of nitrate present.

Dr. Orr, Director of the Rowett Research Institute, Aberdeen, recently suggested to the Empire Marketing Board that the results of pasture investigations, which have been carried out in different parts of the Empire with the aid of grants from the Board, should be brought together and reviewed in a form convenient for the use of bodies and persons who are responsible for applying the information to local conditions and bringing it into general practice. This proposal was discussed between Dr. Orr, Professor Stapledon of the Welsh Plant Breeding Station, and Professor Richardson of the Waite Institute, University of Adelaide. As a result Dr. Orr and Professor Stapledon have agreed to co-operate in preparing this report with the help of collaborators in oversea Empire countries and the Imperial Bureaux of Animal Nutrition and Plant Genetics.

ANIMAL HEALTH

Parasitological Research in Canada

Last year's report referred to a decision of the Board to share with the National Research Council of Canada the cost of maintaining an Institute of Helminthology at Macdonald College, McGill University, Montreal, for the investigation of parasitic diseases of domestic animals.

The Laboratory buildings have been completed and equipped during the year with funds provided by the Quebec Government. Dr. T. W. M. Cameron, formerly of Edinburgh University, has been appointed Director of the Institute and work started on the 1st April, 1932. The establishment of the Institute has been welcomed by agricultural and lay opinion in Canada.

The administration of the work is under the control of a specially appointed Associate Committee on Parasitology of the National

Research Council, of which Dr. H. M. Tory, President of the Council, is Chairman. At its third meeting the Committee had under consideration the steps which should be taken to ensure that the Board was kept fully informed of the activities of the Institute and it was agreed that Dr. R. T. Leiper, Director of the Imperial Bureau of Agricultural Parasitology in the United Kingdom, should be appointed a member of the Committee as a nominee of the Empire Marketing Board.

The Institute is beginning its work with a survey of the parasites in the Dominion and is investigating the control and life histories of some of the more important species. The first investigations will be concerned with parasitic diseases of sheep, pigs and poultry. The Director has already been in touch with interested persons in the West Indies and has offered assistance in diagnoses and advice in connection with their parasitic problems.

Animal Health Research in Australia

Good progress is being made with the scheme for animal health research in Australia, which, as stated in last year's report, consists of two programmes, one dealing with diseases affecting the sheep raising industry, and the other with diseases affecting the cattle industry in Northern Australia.

As regards sheep diseases, investigations completed deal with black disease and braxy-like disease of sheep, both of which cause great losses. Effective vaccines have been developed and have given excellent results. In each case the formula has been handed over to the Commonwealth Serum Laboratories. Several species of internal parasites, hitherto unrecognised, have been discovered particularly in regard to fluke infestation and stomach parasites, and improved preventive measures have been applied with outstanding success in many districts. The results of studies of "pulpy kidney" in lambs and of *caseous lymphadenitis* of sheep have been published, and work is under way on foot rot of sheep.

As regards cattle diseases, an Advisory Committee has been appointed during the past year to advise the Commonwealth Council for Scientific and Industrial Research in regard to the conduct of researches at the Townsville Laboratory in Queensland. This Committee is composed of representatives of the Council for Scientific and Industrial Research, the State Government of Queensland, the

Graziers' Association, and the Council of Agriculture. It has been decided to concentrate research in the early years on problems associated with ticks and tick fever, pleuro-pneumonia, tuberculosis, and "peg-leg" disease, but, in periods of low incidence or as the occasion offers, due attention will be given to other problems forming part of the Laboratory's programme. One of the workers at the Laboratory, Dr. Legg, has been sent to South Africa to study developments which have taken place, particularly in regard to ticks and tick-borne diseases, at the Onderstepoort Veterinary Research Station. Field work on "peg-leg" disease has been assisted by the establishment of a small field station which certain cattle interests in Queensland have combined to equip and manage.

Onderstepoort Veterinary Research Station, South Africa

Library Building.—This building, which was completed during the early part of 1932, was equipped and occupied during the latter part of the year and was formally opened by His Excellency the Governor-General of the Union of South Africa, The Earl of Clarendon, on the 12th October, 1932. Since its completion this building has proved to be a most valuable addition to the Onderstepoort Research Institute.

The Work of the Research Fellows.—Mr. R. A. Alexander, B.Sc., B.V.Sc., the Research Fellow appointed to undertake researches on virus diseases and tissue culture, was occupied through the year with research on the following virus diseases: Bluetongue, Louping Ill,* Horseshickness,† Rabies, Heartwater, and has continued his studies of tissue culture. He succeeded in transmitting *Louping Ill* by the African tick *Rhipicephalus appendiculatus*, and achieved results of considerable importance in transmitting African *Horseshickness* to mice and guinea-pigs. This will enable work to be greatly increased in many directions, and it has already been possible to demonstrate the existence of at least three separate strains of the Horseshickness virus, differing with respect to immunity.

Preliminary work has shown that it is possible to maintain the neurotropic strain of horseshickness virus in tissue culture in

* See "The Transmission of *Louping Ill* by *R. appendiculatus*" in collaboration with W. O. Neitz, to appear in *Veterinary Journal* now in press.

† Preliminary note on the infection of mice and guinea-pigs with the virus of Horseshickness. *Journal of South African Vet. Med. Assn.*, 4, 1, 1-9.

Maitlands medium. It is hoped to place this phase of the work on a routine basis so as to commence the study of the propagation of the virus in a cell per medium.

Mr. J. H. Mason, M.R.C.V.S., holder of the Fellowship for bacteriological and physiological research bearing on the health of stock animals, particularly ruminants, has continued his studies of intestinal flora of sheep. The work has made considerable progress, but the main result so far has been the demonstration of the comparative rarity of pathogenic or toxigenic bacteria. Only one form of undoubted pathogenicity (*B. welchii*) has yet been encountered, and no cellulose-splitting organism has been found. Improved methods for the cultivation of anaerobes are being studied, and a method of isolating single bacterial cells has been worked out (an adaptation of Fortner's well known micro-plate technique). An electrically heated apparatus for making micro-pipettes has been devised. This device has greatly simplified the micro-technique and a description of it has been published.*

The work of Dr. C. Rimington, holder of the Fellowship for the chemical investigation of poisonous plants, can be summarised as follows :—

The isolation and chemical characterisation of the toxic principles of *Cucumis* species has been successfully concluded. Work upon *Geigeria passerinoides* and *Dichapetalum cymosum* still continues, whilst another plant, *Psilocaulon absimile*, has been investigated and two separate poisonous principles identified. The investigations upon this plant are in the last stages of completion.

The greater portion of the time, however, has been allotted to a study of the disease "Geeldikkop" or "Yellow-thick-head," as a cause of which the plant *Tribulus* sp. has been incriminated by various observers. A lethal factor present in the press-juice or watery extracts of the plant has been traced to the formation of a toxic substance by an enzymic system in the plant. This factor may or may not figure in the development of the typical disease.

* Zentralblat f. Bakt.

Other investigations have been upon more physiological lines in an endeavour to ascertain the cause of the icterus and photosensitivity seen in affected animals. Already results of far-reaching importance are being obtained.*

Mineral Survey Work.—This work, which has been conducted under the direction of Dr. A. I. Malán, has extended very appreciably during the last year. The original object of the work as set forth in last year's Report still holds good. Several additions and extensions of the methods employed have, however, been made. Plots of a number of indigenous grasses have been established for the study of the change in the mineral composition of grasses with stage of growth and soil composition. Whereas grass samples were being sent in from only forty areas in 1931 the number has now increased to approximately 200, distributed as uniformly as possible over the Union of South Africa. The survey from blood analyses has developed into a continual survey instead of a seasonal one.

These changes, modifications and extensions, while greatly increasing the number of analyses which have to be made, give the investigation a much wider field as it sets forth an attempt to study a very important problem in all pastoral countries on a sufficiently broad basis to make the results significant. The first report on this work has been published.† A further report is in preparation at present and will appear towards the end of this year.

The work on the relation between the iodine content of foodstuffs and the incidence of goitre in several localities in the Union is progressing favourably and a report upon this work is now in the press.

Work on Dips and Dipping.—Steady progress over the period under review has been maintained in this work which is under the general direction of Dr. H. Graf. Most time was devoted to lime-sulphur solutions as dips, several aspects being investigated and three reports being published.‡

* *Publications* : Isolation and Chemical Examination of the Poisonous Principles of *Dimorphotheca spectabilis* Schltr. and *Dimorphotheca Zeyheri* Sond. 18th Report of the Director of Vety. Serv. & Anim. Indust., Union of South Africa, August, 1932.

† "A Study of the Mineral Content and Feeding Value of Natural Pastures in the Union of South Africa." 18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, August, 1932.

‡ Lime-Sulphur Dips :—(i) General Introduction ; (ii) A new Laboratory Method of Chemical Analysis ; (iii) A Preliminary Study of a Colorimetric Method as a rapid Means of Control of Polysulphide Solutions. 18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, August, 1932.

Further research work has been conducted, the scope of which is summarised in further papers ready for publication.

These reports are the outcome of the work done on the various points of the 1932-33 programme and give an accurate summary of all the investigations undertaken. At present the energies of the researchers are being concentrated on the following points:—(i) The adaptation of the new calorimetric method for field testing purposes; (ii) a continuation of and closer study of the effects of dips on wool; (iii) the effect of suint on dips; (iv) the *via media* of destruction of ticks by arsenical solutions; and (v) the effect of ingested arsenic on wool, a problem in which already a considerable amount of work has been done.

If facilities can be made available it is the intention to study what effect micro-organisms exert on the dipping fluids exposed in tanks. This aspect may produce interesting data in explanation of changes occurring in exposed dips.

Helminthological Problems.—Dr. R. J. Ortlepp continued his investigations during the year on the life histories of *Moniezia* and *Gaigeria*, on poultry parasites and the helminth parasites of wild fauna, and on the effects of lime on the development of helminth larvae in the field. An experiment is proceeding to see whether sheep can naturally become infected with helminths of antelopes.

Tsetse Fly Investigations.—This work is carried out under considerable difficulties in the Tsetse Fly Belt of Zululand. Mr. A. B. Whitnall, M.Sc., has conducted a series of very interesting investigations on the problem of the transmission of Nagana by means of ordinary biting flies. He also made a careful study of the infection as it occurs in *Glossina*.*

Mr. Whitnall has also studied in conjunction with Mr. R. H. Harris the problem of the flagellate infection of plants and the possibility of transmitting these parasites to Tsetse flies. A report on this subject will be published shortly.

* See 18th Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, August, 1932.

Preliminary Survey in connection with the Immunisation of Cattle against Redwater and Anaplasmosis

In June, 1932, the Board, on the recommendation of the Colonial Advisory Council of Agriculture and Animal Health and the Director of the Onderstepoort Veterinary Research Laboratory in South Africa, made a grant for the carrying out of a preliminary survey in connection with a scheme of immunisation of cattle against Redwater and Anaplasmosis. Although a method of immunisation is known, its application entails the maintenance of selected parasites under tick-free conditions. Of the Colonies concerned facilities for such maintenance exist only in Kenya. If immunisation were carried out in the United Kingdom, improved stock could be introduced into Colonies where this has hitherto been impossible. The maintenance of parasites under tick-free conditions could be carried out in this country; but, before a general scheme of immunisation can be drawn up, a preliminary survey of the various strains is necessary since the parasites of different Colonies manifest some divergence. The Ministry of Agriculture have agreed to tests being carried out at the Veterinary Research Laboratory at Weybridge and the scheme has been drawn up in consultation with the Director of the Laboratory.

Appointment of Biochemist at the Veterinary Research Laboratory of the Ministry of Agriculture and Fisheries at Weybridge

A grant was approved by the Board in June, 1932, for the appointment for one year as from the 1st October, 1932, of Dr. H. H. Green as Biochemist at the Veterinary Research Laboratory of the Ministry of Agriculture and Fisheries at Weybridge.

Three major problems of importance both to this country and other parts of the Empire, viz. contagious abortion of cattle, fowl paralysis and coccidiosis of poultry, which are being investigated at Weybridge, urgently required the co-operation of a chemist with the type of training and experience possessed by Dr. Green.

WOOL

Wool Industries Research Association, Leeds

Wool Production.—As a sequel to the work carried out in previous years and the conclusion of the Empire Wool Survey, biological studies have been prosecuted under three main categories to

determine :—(i) the conditions under which different types of sheep are maintained, (ii) the kinds of wool produced under these conditions, and (iii) the effects of changes in environment upon fleece characters.

The first group of problems includes the various aspects of sheep ecology and distribution ; the second embraces the distribution of wool types and the study of the variability of fleece characters in ordinary circumstances as a preliminary to the attack upon the third category, within the scope of which are included investigations on the inheritance of wool characters, and breed inter-crosses involving altered environment. The study of factors influencing the distribution of the various breeds in the British Isles has been studied more especially in relation to the analysis of climatic conditions. By comparison of the hythergraphs for a breed in its native localities with those of other districts and countries, the probability of successful introduction or dispersion of that breed into other climates has been estimated in several cases.

A method of assessing the flexibility of a breed in respect of adaptation to novel climatic conditions has been proposed, and a report presented covering these points. Work is also proceeding upon a study of the distribution of sheep types in Australia, and environmental conditions such as rainfall, vegetation and geological formation have been considered for several countries preparatory to investigation of the possible associations of sheep with such influences of habitat.

Information on wool types in New South Wales has been collated and mapped to allow correlation with sheep maps, etc. For the same purpose maps have been constructed to show fleece weights, quality and shrinkage in the United States of America. These will shortly be published.

Material collected during the Empire Survey has been analysed from various aspects, in particular Riverina Stud Merino wools have been examined to determine the nature and amount of lock to lock variation and fibre length, fineness and crimps per fibre.

The effects of general environment on wool growth have been investigated in the case of an unusual sample from New South Wales. Sudden changes in quality along the staple have enabled comparison to be made between fibre length increase, fineness and fibre volume in the several stages of growth.

The inheritance of wool characters in half-bred sheep has been followed, and has involved the detailed examination of wool of representatives of the parental breeds and the first and second hybrid generations. Further evidence of a multiple factor basis of fleece inheritance has emerged. A report upon a cross of Border Leicester and Cheviot sheep is now ready for publication.

Professor J. E. Duerden, lately Director of Wool Research, Union of South Africa, has been afforded facilities for carrying out work upon the phylogeny of the fleece in the Association's laboratories. The Australian Commonwealth Council for Scientific and Industrial Research has deputed a scientific officer to study in the biochemical laboratories at Torridon the chemistry of wool in connection with blow-fly problems.

In the wool fibre department work has been continued upon the technique of measurement and assessment of fibre attributes in relation to mechanical processes of industrial manipulation. The results obtained previously for wool quality values are proving to be in good agreement with trade practice. A study of crimp and twist in fibres in relation to follicle activity and causes of formation is leading to interesting results, many of which have been published during the year.

Wool Packs.—The search for a suitable medium for the manufacture of wool packs free from surface hairs which might penetrate into the wool has continued. The continuation of the earlier work upon paper packs was temporarily postponed in order to consider the possibility of rendering ordinary jute packs innocuous by means of suitable impregnation. Cellulose and rubber treated packs have been sent to Australia and returned filled with wool. Whilst considerable progress was attained, there remain many factors to be further considered. The question seems to be largely resolving itself into one of economics, since an increase in the price of the pack must, if at all necessary, be very small. This proviso limits the field of activity greatly, but it is hoped that this year the Dominion tests will again indicate a considerable amount of further progress towards the attainment of the object in view.

Biochemistry.—The study of the sulphur content of wool in relation to production, i.e. diet, environment, nutrition, etc., and the natural corollary of variation in response to manufacturing processing,

has been elucidated further. The variation in the sulphur (and cystine) content of wool keratin has been confirmed by a further series of experiments, and its relation to some fibre characteristics established. A scheme for the isolation and estimation of individual amino acids in wool keratin is being worked out, and the acids determined quantitatively.

Wool Fibre Research Committee.—The Wool Fibre Research Committee has continued its activities. In conjunction with the British Wool Federation, representative samples of various qualities of New Zealand wools have been selected as typical standards and submitted to New Zealand. An exhaustive analysis of Basuto wools has been made, a memorandum has been submitted on the classification of Natal wools, and reports have been furnished on wools from Bihar and Orissa, Iraq and Syria.

DAIRYING

Studies on Cheese-Ripening

For the three years ended the 31st March, 1932, a fund provided jointly by the Empire Marketing Board and the University of British Columbia enabled Professor Wilfrid Sadler and Dr. Blythe Eagles to undertake studies of cheese-ripening processes and on the lactic acid bacteria. The work done on the proteins and the lactic acid bacteria has thrown light on the nutrition of these bacteria, and on the influence on their nutrition of certain vitamin-bearing substances, and several hypotheses as to the possible relation between the ripening process and the nutritional value of cheese have suggested themselves. Some of the results of the studies have been published.*

The work was temporarily suspended during 1932 as the University of British Columbia found it impossible to share with the Board the cost of a further year's continuance. The National Research Council of Canada has, however, now authorised a contribution to the work on a 50/50 basis with the Board. The result is that work was resumed as from the 1st February, 1933, and is provided for to the end of September.

* Eagles and Sadler, 1931 : *Nature*, 127, 705. Eagles and Sadler, 1932 : *J. Dairy Research*, 3, 227. Eagles and Sadler, 1932 : *Nature*, 130, 278. Eagles and Sadler, 1932 : *Canadian J. Research*, 7, 364. Sadler, Eagles and Pendray, 1932 : *Canadian J. Research*, 7, 370. Sadler, Eagles and Pendray, 1932 : *Biochem. J.*, 26, 1532.

"Openness" in Cheese

The investigation into the problem of "openness" of texture in cheese, which has been in progress at the New Zealand Dairy Research Institute since April, 1931, with a grant from the Board, has been continued during the year. Intensive investigation into this and other problems, such as discoloration in cheese, has shown the need, as in many other fields of research, for organising the attack along both fundamental and applied lines.

Many factors influence the defect of "openness" which has three distinct types, two of which are generally associated with other defects in quality and the third, to a limited extent, with cheese of finest quality. It has been shown that the trouble may be attributed to or aggravated by any or all of the following conditions:—low grade milk, inactive starters, faults in manufacture, the aim for excessively high yields, undue hastening of the manufacturing process, excessively high curing-room temperatures, and the sale of cheese before it is properly matured. Fundamental studies on the bacteriological and chemical aspects of these problems are being pressed forward and laboratory work is being co-ordinated with the manufacture of cheese in the experimental dairy factory. Close contact is being maintained with the related work on cheese ripening processes being carried out by Professor Sadler and Dr. Blythe Eagles at the University of British Columbia.

The fundamental work is proving of value not only in the solution of specific problems but as a contribution to the wider problem of efficient cheese manufacture in all producing countries.

Study of Tuberculous Infection of Milk

This study, designed to ascertain the extent of infection of the milk supply of Scotland and, in particular, the relative degree of infection of milk from different localities and of milk treated by different processes, has been completed. The results are of a conclusive and significant character and provide authoritative evidence which should be of considerable value to Public Health and Agricultural Authorities concerned with the application of control measures. A full report has been prepared for publication.

The Condensing and Drying of Milk and Milk Residues

Reference was made in the Annual Report for 1929–30 to a detailed and exhaustive search of the literature on the condensing and

drying of milk and milk residues which was being undertaken by the Hannah Dairy Research Institute with a grant from the Board. This, it was mentioned, would supplement the Report on "Surplus Milk and Milk Residues" prepared by Mr. A. Macneilage and issued in 1929 as Bulletin No. 1 of the Institute.

This work was completed during 1932 and two comprehensive reports have been published. The first,* by Dr. L. A. Allen, surveys the literature relating to the chemical, bacteriological and nutritional aspects of condensing and drying of milk and milk by-products; and it draws attention to the more important gaps in existing knowledge and the most profitable lines along which future research might be developed. The second report,† by Dr. A. W. Scott, reviews the engineering aspects of the condensing and drying of milk. These reports have been circulated to all oversea Empire countries interested. They have been found of considerable value to South Africa, where the drying and condensing of milk is now firmly established, to Jamaica where interest is being taken in the question of producing condensed milk in the Colony, and to Kenya where creameries have been developed which may not be able to absorb the increasing quantity of milk produced in the Colony. Enquiries have also been received from Canada, Australia, New Zealand and India.

In addition to the full report, Dr. Allen collected a good deal of useful information on the subject of the mineral constituents and citric acid content of milk. This section of his work has been published separately in the Journal of Dairy Research.‡

Bacteriological technique of Milk examination

The Annual Report for 1930-31 referred to a grant to the London School of Hygiene and Tropical Medicine for an investigation into the bacteriological technique of milk examination.

The investigation started in October, 1931, and considerable progress has been made, one of the most important developments

* "The Properties of Milk in Relation to the Condensing and Drying of Whole Milk, Separated Milk and Whey," by L. A. Allen, M.Sc., Ph.D. Bulletin No. 3 of the Hannah Dairy Research Institute (price 4s. 6d., post free 4s. 9d.).

† "The Engineering Aspects of the Condensing and Drying of Milk," by A. W. Scott, B.Sc., Ph.D., A.M.I.Mech.E. Bulletin No. 4 of the Hannah Dairy Research Institute (price 4s. 6d., post free 4s. 9d.).

‡ The Journal of Dairy Research, Vol. III, No. 1, December, 1931.

being the devising of a new medium, which has given very promising results both at the London School of Hygiene and Tropical Medicine and at the National Institute for Research in Dairying at Reading. The errors of a number of steps in the plate counting technique have been measured, such as those concerning pipettes, diluents, method of making dilutions, and duplicate counting of plates. Two experiments made on a fairly large scale with several workers have shown that one of the most serious errors in the whole technique is due to the difficulty in counting colonies which are so small as to be on the borderline of resolution by the naked eye. Counting identically the same plates under the same conditions, different workers, all highly experienced, obtained results not infrequently differing by over 100 per cent. The possible methods of diminishing this error have been discussed. Extremely interesting results have been obtained by the analysis of data, submitted by the National Institute for Research in Dairying, concerning the information afforded by the use of the plate count, the *coli* count, and the methylene blue reductase test in predicting the keeping quality of the milk. A second analysis is now in progress to determine the errors of the plate counting technique when performed by the Ministry of Agriculture's method. The preliminary results indicate that, when duplicate analyses are made of the same milk by two skilled workers at the same time, the results obtained might differ by as much as 60 per cent.

With regard to the methylene blue reductase test it has been found that the present method of performing it is open to serious error. During the progress of the test the cream tended to rise and to carry with it a large proportion of the organisms in the milk, with the result that the reduction time was unduly prolonged. By fitting the tubes with sterile rubber corks and inverting them every thirty minutes, much more satisfactory results have been obtained. It is apparent, however, that before the real value of the method can be determined, it is necessary to study the mechanism of the reduction more thoroughly. With this end in view an electrical apparatus for the measurement of oxidation-reduction potentials has been constructed and it is hoped shortly to be able to study the actual alterations in Eh that occur during the multiplication of bacteria in milk.

Standardisation of Volumetric Glassware used for Testing Milk and Milk Products

The Sub-Committee of the Dairy Research Committee which is dealing with this question has continued its work during the year

and good progress has been made. At a recent meeting the Sub-Committee had the opportunity of meeting one of the Butter Instructors attached to the Dairy Division in New Zealand, and a useful interchange of views regarding Babcock Cream Test Bottles took place.

The Sub-Committee has completed its draft standard specifications for glassware used in the Gerber, Babcock and Leffmann-Beam tests, and also its draft standard directions for determining the percentage of fat in milk and milk products using the proposed standard apparatus. Sample apparatus for the Gerber and Babcock methods, made in accordance with the proposed standard specifications, has been obtained, tested at the National Physical Laboratory for conformity with the specifications, and distributed to certain members of the Sub-Committee for trial and comparison with a gravimetric method. These trials involve a large amount of experimental work and are not yet quite complete. The results so far available are, however, very promising. Similar trials with the Leffmann-Beam apparatus will be carried out when the present series of experiments with the other methods is completed.

In addition to the determination of the percentage of fat in cream and cheese with special Gerber butyrometers designed for this purpose the Sub-Committee is trying out alternative methods employing the ordinary Gerber milk butyrometer.

Preliminary consideration has been given to the preparation of a standard specification for a lactometer. Examination of a number of typical lactometers in current use has shewn that, for most of them, the changes in their readings occasioned by changes of surface tension are incompatible with the degree of accuracy required of the instruments. The Sub-Committee hopes to proceed in the near future with the design of a standard lactometer paying due attention to surface tension effects.

POULTRY

Research on the Scientific Feeding of Poultry at the Poultry Nutrition Section, Animal Nutrition Institute, University of Cambridge

At the request of the Imperial Institute, the possible use of palm oil as a mutton fat substitute in fattening hens received attention. The results have proved favourable to the use of this material in

fattening rations, neither the quality of the carcase, its palatability nor flavour being adversely affected. (See Bulletin of the Imperial Institute, 1933, 30, 312.)

The technique evolved for the study of fat metabolism of the bird has already yielded results of importance, both from the fundamental and practical points of view. It has been ascertained that the composition of the body fat of birds can be modified by the nature of the fatty fraction of the food material. The character and quality of birds intended for table can, therefore, be materially influenced by the nature of the fat included in the food, and by choice of suitable fats a poultry keeper is thus enabled to modify the character of the carcase produced in any direction he wishes.

It has further been ascertained that the nature and composition of the fat in egg yolk can also be affected by the nature of the fats included in the food material, but the effect on the yolk fat is more selective than in the case of body fat. Inclusion of fats of the saturated fatty acid type (palm kernel oil and palm oil) do not markedly affect the composition of the yolk fat. On the other hand, fats of the unsaturated fatty acid types do. Apart from the possible effects these induced changes in composition of yolk fat may have upon technical processes in industry where egg oil is used, its physiological significance needs investigation. The fats in the yolk play an important part in the energy metabolism of the developing embryo, and any change in the chemical characteristics of such fat may conceivably influence the hatchability of the egg and the viability of the chick produced. It is intended to devote attention to this latter problem as soon as suitable material is available for this purpose.

Poultry Nutrition Research at the Rowett Research Institute, Aberdeen, and the Hillsborough Experimental Station, Northern Ireland

The results of large scale experiments, where birds have access to good grass and clover runs, are applicable to the general commercial poultry keeper, and investigations of this type have been carried out in the studies of growth and egg production. Under these conditions, of the mineral supplements tested, common salt has given the best results for both chickens and pullets, the sodium being apparently the important factor. The best percentage of salt to use is being studied, as also is the effect of salt on egg production where the runs are kept free of grass.

Under range conditions it is found unnecessary to have a high percentage of protein in the mash for hens, and the minimum amount required is being investigated.

In growth experiments, from a comparison of cereal rations with soya bean meal as the protein supplement and earlier rations containing milk, it would appear that the greatest benefit of milk is during the first three months of growth. It was also previously thought unnecessary to add minerals to a cereal ration containing milk, but from further work it would appear that salt does improve this ration, especially during early growth.

The effect of different times of hatching on growth and egg production have been studied. While early hatched birds laid somewhat earlier than those hatched later, the most profitable time of hatching appears to be between the middle of March and the middle of April.

Most of these experiments have been planned jointly and done both at the Hillsborough Station and at the Rowett Research Institute.

Other work, at Aberdeen, on the physiology of nutrition of the fowl is as follows. Experiments are being carried out to show the effect of vitamin D on the mineral metabolism of cocks and pullets. Blood analyses have shown that large doses of the vitamin affect the serum Ca and the phosphatase of the plasma. The latter appears to be high in birds laying a large number of soft shelled eggs, and in those birds which are not laying due to a deficiency of vitamin D or minerals. Ill effects of over-dosage of vitamin D appear to be different in the two sexes, owing possibly to the fact that when a hen is laying, the serum Ca will ordinarily rise to two or three times the normal non-laying level.

In continuation of the work on the carbohydrate metabolism of the fowl, it has been shown that the absorption and utilization of the simple sugars in the chicken differs somewhat from that found in the rat. The absorption of glucose is very rapid, and, unlike that in the rat, does not remain constant while there is still sugar to be absorbed. The results of some studies on digestion and absorption have been published. Work on the respiratory metabolism of the fowl is also in progress, with a view to elucidating further some questions regarding the utilization of carbohydrates.

At the request of the Northern Ireland Egg Trade the Hillsborough Station, in conjunction with technical officers of the Ministry of Agriculture for Northern Ireland, has devoted considerable time to an effort to solve the problem of "watery whites" in eggs—a problem which has given rise to much difficulty in the trade and considerable loss to producers. Over a period of two years a number of factors, including the liability of various breeds to produce "watery whites," the system of management, e.g. free range versus semi-intensive, low versus high feeding, etc., have been examined. None of these factors appears to be responsible to any appreciable extent for the condition known as "watery white." In the course of the investigation it was necessary to bring eggs by road a distance of 18 miles to the Hillsborough Station. All these eggs had been packed broad end (air cell) down and in spite of the fact that the eggs were only 24 hours old they showed on testing a remarkably high proportion of "watery whites." This clue has been followed up by sending consignments of eggs, half packed broad end up and half packed broad end down, on journeys by motor lorry and train, and across to markets in England. The results confirm previous indications and a report is in course of publication. The Ministry of Agriculture for Northern Ireland is now exploring this problem further through all phases of the egg trade and has communicated the results to the English Ministry of Agriculture and Fisheries and invited their co-operation. A further interesting fact has emerged from this investigation, namely, that if the vibration and jolting received in transit has not been excessive the condition known as "watery white" will disappear in a few hours if, after receipt at the packing house, the eggs are stored broad end up.

Investigations into the Production and Marketing of Table Poultry, Eggs, etc., at the Harper Adams Agricultural College

Table Poultry.—From experiments carried out with table chickens at the National Institute of Poultry Husbandry, the following conclusions were drawn :—

- (i) That slipped tendons and allied leg disorders in battery-reared chicks is due to an improper balance of calcium and phosphorus in the food ;
- (ii) that with proper feeding and management battery-reared birds gave as good growth results as floor-brooded chicks ;
- and (iii) that in confirmation of the observations made at the Hillsborough Experimental Station,

Northern Ireland, chickens fed on very good rations leave little scope for an intensive period of fattening. Further experiments are in progress to determine the most economic methods of rearing and fattening chickens.

Ducks.—Meat and bone meal has proved as valuable a supplement as the more expensive fish meal in laying rations. Further trials are in progress with soya bean meal and the more expensive animal proteins for egg production.

Turkey Production.—Intensive methods of rearing turkeys have given very satisfactory results in growth, and a marked reduction in the incidence of blackhead disease.

Egg Quality Studies.—In a survey of all eggs produced on the Institute plant no correlation could be traced between the quality of egg-white and the character of the different rations fed. Some evidence was obtained that quality of egg white is more specifically an individual characteristic than a condition induced by nutritional factors.

Quality in Eggs and the Effect of Dietary Factors on Hatching Capacity.

The Annual Report for 1929-30 referred to a five years' grant to the Ontario Agricultural College, Guelph, in aid of a study of quality in eggs and the effect of dietary factors on the hatching capacity of eggs. This study was planned as the result of a visit to the United Kingdom of Professor W. R. Graham, Professor of Poultry Husbandry at the College, in 1927, when he discussed co-operation in poultry research with representatives of the three home Agricultural Departments and the Rowett Research Institute in Scotland.

The scheme started in January, 1928. A report on the results of the first three years' work was published in March, 1931.* Copies of this report were circulated by the Board to home and oversea research organisations interested, and it has proved of particular interest to the Wallaceville Poultry Experimental Station in New Zealand in connection with the use of buttermilk powder in the feeding of poultry. A further report, covering five years' work, has now been received by the Board. The study of protein concentrates has shown

* "Results of a three years' study of certain Poultry Rations as they affect the hatching power of hen eggs as well as the number of eggs laid." Bulletin No. 362 of the Ontario Department of Agriculture.

distinct differences in their influence on egg production and hatchability, which indicate that there is a wastage of protein, as judged by their effect in a ration. The experiments have further suggested that the cereal grains in a ration influence egg production and hatchability, as well as the kind of protein supplement fed. The value of sunshine and sunshine substitutes, such as cod liver oil, has been definitely established, but there is a suggestion that the value of the antirachitic vitamin may also be influenced by the protein of the ration. Such results point to a balance of amino acids in the rations. A study of the ration as utilised by birds on a "free-choice" diet bears out this wastage of protein, and indicates an economical type of ration which could be realised by a proper blend of the amino acids from the cereals and protein supplements.

An experiment to determine the influence of various protein levels on egg production and hatchability and the effect of various protein supplements with different cereal mixtures, and with single cereals, has been planned, and continued study is also proposed of the comparative value of irradiation, cod liver oil and irradiated ergosterol. Further biological studies are proceeding on the relationship between such factors as genetics, body weight, feed consumption, hatchability, egg production and egg weight, and on the reduction of excessive embryonic mortality.

A poultry research worker from the Ontario Agricultural College is at present in this country studying at the Rowett Research Institute, Aberdeen, the physiology of the fowl. He is preparing, for publication in the Board's "Grey Book" series of reports, a memorandum on Recent Advances in Poultry Husbandry.

EXPORT OF PEDIGREE LIVESTOCK

London Quarantine Station

The London Quarantine Station continues to prove of great value in facilitating the export of pedigree livestock to oversea Empire countries. The number of animals which have passed through the Station since its opening in 1928 now totals 2,352. These animals have gone to Australia, the Union of South Africa, Northern Ireland, the Irish Free State, Southern and Northern Rhodesia, Nigeria, the Gold Coast, Trinidad, Antigua, Cyprus and Palestine. An important development in the past year is that, under the provisions of the

United Kingdom—Canada Trade Agreement concluded at the Ottawa Conference, the Station has been recognised by the Canadian Government. That Government has notified officially its willingness to allow the import into Canada of pedigree cattle, sheep, goats, other ruminants and swine from Great Britain provided that the animals have been quarantined at the Station for 14 days immediately preceding embarkation for Canada. The effect of this is that the import of such stock into Canada is now permitted during periods when the United Kingdom is not entirely free from foot-and-mouth disease.

The five years period for which the Board's grant to the Station was originally approved expired at the 31st December, 1932. Owing to the economical and efficient administration of the Station by the Royal Agricultural Society of England a balance from the grant remained unspent at that date and the Board has agreed that this unspent balance may be used for continuing the Station's work. The Board again wishes to express its appreciation of the valuable services of the Royal Agricultural Society of England in the management of the Station.

HIDES AND SKINS

Processing of New Zealand Pelts

The Annual Report for 1930-31 referred to a grant to the New Zealand Department of Scientific and Industrial Research to meet half the cost of research on the processing of New Zealand pelts.

The Leather Research Chemist, who is responsible for the work in New Zealand, has visited England and established personal contact with manufacturers who are buyers of New Zealand pickled pelts. Arrangements have been made for the British Leather Manufacturers' Research Association to carry out research work with the object of eliminating faults and generally improving quality. A start has been made on research into the pickling process which, it is hoped, will yield information as to the correct amounts and proportions of acid and salt required for the effective preservation of pelts. A large number of trial casks of pelts have been treated by different methods in New Zealand and manufactured into leather in this country. The leather has been inspected by technical experts and recommendations have been made by them for modifications in the particular process used. A New Zealand Pelt Committee has been set up in this country

at the request of the New Zealand Government. This Committee consists of members of the British Leather Manufacturers' Research Association, technical representatives of some of the largest users, and New Zealand Government officials, with the Scientific Liaison Officer of the New Zealand Department of Scientific and Industrial Research as Chairman.

The improvement already brought about by this work has established confidence among manufacturers and its continuance will, it is confidently believed, result in much larger quantities of New Zealand pelts being used in the United Kingdom.

ENTOMOLOGY

Parasite Laboratory, Farnham Royal

During the past year investigations have been continued on a number of serious insect pests on behalf of Governments in the Dominions and Colonies.

Consignments of parasites of the Balsam Woolly Aphis and the Western Wheat-stem Sawfly were despatched to Canada; of the Pine Chermes, the Codling Moth, the Greenhouse Whitefly, and the Cabbage Caterpillar to New Zealand; of the European Corn Borer to the West Indies for use against the Small Moth Borer of sugar-cane; of Nettle Grubs to Ceylon, for use against the species of this group attacking tea; of the *Cryptolaemus* Lady-bird attacking Mealy Bug, and of the *Aphelinus* parasitic on the Woolly Aphis to a number of correspondents in Great Britain. Shipments of insects attacking Ragwort have also been sent to New Zealand.

The Entomologist of the Australian Commonwealth Council for Scientific and Industrial Research, who is attached to the Laboratory, has continued to investigate and ship to Australia the insects attacking St. John's Wort, and has also studied and shipped predators of the Pine Chermes, and parasites of the Greenhouse Whitefly.

During the calendar year of 1932, 62 consignments, comprising in all over 344,000 specimens of beneficial insects, were sent out from the Laboratory.

Owing to the restriction of the grants from the Empire Marketing Board, it was necessary to confine the work of the Laboratory almost entirely to investigations partly financed by Dominion and Colonial

Governments. Two members of the staff were engaged during the summer and autumn of 1932 in the study and collection of the parasites of the Spruce Sawfly, *Diprion polytomum*, in Germany, Czechoslovakia, and Austria, on behalf of the Canadian Government. At the request of the Dominion Entomologist, a special investigation of the natural enemies of the Balsam Woolly Aphis was also initiated, and further large-scale collections of the parasites of the Western Wheat-stem Sawfly were made. Special funds for these investigations were provided jointly by the Canadian Government and the Empire Marketing Board. Another special project, undertaken with the aid of subsidies from the New Zealand Government, was the study and the collection of the parasites of the Cabbage Caterpillar. Funds in aid of the study of Bark Beetles were also supplied by New Zealand, and a special investigation of this subject, in co-operation with the Forestry Commission, has now been planned. The breeding of *Aphelinus mali* for use against the Woolly Aphis of apple in the British Isles and of the *Cryptolaemus* Lady-bird attacking Mealy Bug, for distribution in infested greenhouses, has been continued. The study and collection of the natural enemies of the Beech Coccus and the Pine Shoot Moth, both extremely injurious in Canada, have been planned for the coming year.

The grant available for Noxious Weeds Research, carried on at the Laboratory on behalf of New Zealand, became exhausted during the year. Work on this project was therefore discontinued; but a report, embodying the scientific results of the investigation, is in preparation.

Biological Control of Insect Pests in the West Indies

During the past year, Dr. J. G. Myers, of the Imperial Institute of Entomology, has continued his investigations into the biological control of insect pests in the West Indies and parts of South America. The *Lixophaga* parasite of the *Diatraea* borer of sugar-cane was successfully introduced from Cuba into Antigua and St. Kitts, where it is being bred in large numbers and distributed in infested fields. A parasite of the Black Fly of Citrus Fruits was also transferred successfully from Cuba to Jamaica, where it seems to have become established.

At the request of the Government of the Bahamas, Dr. Myers carried out a special investigation of the midge problem in the islands. He succeeded in finding the breeding places of these troublesome pests

and formulated comprehensive recommendations for their control. Shortly after completing this work, he proceeded to Brazil, at the request of the planters of Trinidad, to search for the natural enemies of the sugar-cane Froghopper. The results of this exploration are not yet available, but during the early stages of the work, a new and very promising parasite of the Small Moth Borer of sugar-cane (*Diatraea*) was discovered in the upper regions of the Amazon.

Studies on the problem of the *Diatraea* borer of sugar-cane have been continued in Antigua and British Guiana by entomologists working under the supervision of Dr. Myers, and promising results are reported.

Biological Control of Sugar-cane Pests in Mauritius

At the request of the Government of Mauritius a member of the staff of Farnham House Laboratory is to be seconded for the investigation and collection of the parasites likely to control the *Phytalus* beetle of sugar-cane, which has for many years caused severe losses in Mauritius. Mr. W. F. Jepson has been selected for this work, and will proceed to the United States and the West Indies to carry out the preliminary investigations early in 1933. Funds for this work, which is being carried on under the supervision of the Superintendent of Farnham House Laboratory, are being provided by the Sugar Reserve Fund Committee of Mauritius.

Stored Products Research

The Board has continued its support of the Biological Field Station at Slough, whose work is directed against the insects and fungi which infest stored products.

During the past year the entomological work has been concerned mainly with the study of the problems arising in the rearing of large stocks of insects which are used for experimental work in fumigation. Work on the resistance of insects to poisonous gases has produced results of great practical importance which have been specially useful in assessing the results of fumigation on a commercial scale. Experimental work on the rearing of insects is yielding information about their temperature and humidity requirements. This work is of special importance in determining the conditions desired in warehouses and stores to reduce infestation. A beginning has been made in the study of insect respiration and its bearing on resistance to fumigation.

On the mycological side a survey of cocoa at Liverpool has shown that cocoa arrives in England dry enough to prohibit growth of known cocoa fungi, and that germinated cocoa is much more prone to mould attack and to insect attack than sound ungerminated cocoa. The report also indicates that further work on storage conditions both in West Africa and in this country is desirable.

The chemical work has been concerned mainly with the study of fumigation problems. Present day fumigation practice is unsatisfactory because too little attention has been given to the kind of insect material used in experimental tests on fumigants and because no serious attempt has been made to study the behaviour of gases during the actual process of fumigation. With regard to the first question, an extensive series of tests has been made both in the laboratory and in the course of commercial fumigation. These tests show that temperature has a very important effect on the resistance of insects to fumigants and that the variation in resistance to fumigants by different species of insects and by insects in different stages of development is much more important than has been supposed. Work on the behaviour of gases during fumigation has made good progress. An improved method for the measurement of gas concentrations for the control of fumigation has been devised and standardised and has been found entirely satisfactory in practice. The use of this apparatus has yielded valuable data regarding the behaviour of gases during fumigation and its use, in combination with test-insects, enables the efficiency of fumigation to be readily ascertained. An important branch of fumigation work is the determination of the gases both in air-spaces and in foodstuffs, and work has been begun on the fumigants ethylene oxide and hydrocyanic acid gas. The work on hydrocyanic acid gas is not yet completed but improved methods of determining ethylene oxide have been devised.

Progress in practical work has been most marked in dealing with dried fruit. Partly because of advances made in research work on fumigation, the Australian Dried Fruit Board decided to call on the Slough laboratory to advise it on fumigation and to inaugurate improved methods of dealing with infestation. This is an important step because it offers the first real hope of dealing satisfactorily with the infestation of Australian dried fruit, and affords unique facilities for the study of fumigation problems on a commercial scale. The results of this dried fruit work are briefly that over 7,650 tons of fruit

have been dealt with, that still better control can be attained during next season and that a valuable advance in the science and technique of fumigation has been made. The detailed results of this work will not be available for some months but the advance made is of the highest importance both scientifically and practically.

In dealing with cocoa infestation good progress has also been made, especially in relation to fumigation. This work has been concerned first with a study of the climatic conditions prevailing at the docks and their relationship to the prevalence of infestation, and secondly, with the improvement of fumigation technique. In this last part of the work the Station has co-operated with wharfingers and merchants, with professional fumigators and recently with Imperial Chemical Industries.

One important aspect of this work deserves mention, namely, that all fumigants and all methods of fumigation tried out or used in the docks have to be approved by the Public Health Authorities, and by the Fire Risks Committee. The obtaining of the data and preparation of the reports for these bodies has fallen to the Slough Station and recently the Fire Offices Committee in London has insisted that any methods entailing the use of heat or of fumigants which are inflammable or contain inflammable ingredients can be employed only under the personal supervision of the Director or the Chief Chemist. This action on the part of the Fire Offices Committee, while it entails extra work, has considerable value in that it enables the Station to keep in the closest touch with any developments arising in fumigation practice.

Advances of practical importance are also being made on the biological side. In fumigation work, for instance, and even when dealing with the external and practical question of shed fumigation, the chemists have asked for information which was available only because of the biological research.

Apart from research under the general programme of the laboratory two special investigations have been carried out on behalf of the tobacco industry and the furniture industry respectively.

The tobacco investigation has been in progress for three years and during the past year special attention has been given to the control of the moth *Ephestia elutella*, infesting tobacco, by means of low temperature storage. A report on the work up to date has been

completed and will be published shortly as an Empire Marketing Board "Grey Book." The cost of this investigation has been borne partly by the Southern Rhodesian Government and partly by the Imperial Tobacco Company.

An investigation into infestation of furniture and upholstery by the house mite, *Glycyphagus domesticus*, has been in progress during the past year. The life history of the mite has been fully studied for the first time and it has been shown that the hypopial stage is an integral part of the life-cycle and not a special adaptation to unfavourable environment, although it may also serve in that manner. An important discovery is the preference of the mite for fibre and other upholstery materials which are slightly infested by mould fungi and this explains why the mite is so frequently associated with Algerian fibre. This investigation has been financed by the High Wycombe and District Furniture Manufacturers' Federation.

Since April, 1932, provision for four members of the scientific staff, whose appointments would have terminated owing to lack of funds, has been made until July, 1933, by securing funds from outside sources, and one other member of the technical staff, whose appointment terminated in April, 1932, is now wholly employed by the Australian Dried Fruit Board.

Campaign against Locusts

During the past year the Committee on Locust Control of the Economic Advisory Council has issued its Fourth Report.* This describes the functions of the Committee, the work upon which it has hitherto been engaged, and its programme of investigations during 1932-33. The Report also reviews the locust situation during the period May, 1930, to January, 1932, in the various countries infested by the Desert Locust, the Tropical Migratory Locust and the Red Locust.

The Second International Conference for Anti-Locust Research was held in Paris from the 15th to the 23rd July, and was attended by representatives of Belgium, France, Great Britain, Egypt, Italy, Spain, Abyssinia and Liberia. The Conference agreed unanimously that all local efforts for locust control would remain fruitless until

* "Survey of Locust Investigations in 1931 and Programme of Work for 1932-33. Fourth Report of the Committee on Locust Control of the Economic Advisory Council." Cmd. 4124. H.M. Stationery Office. Price 1s. net.

the breeding areas of locusts were thoroughly investigated. A common programme for such research was agreed upon by the Conference, and it is proposed that the investigations should proceed along two major lines. The first consists in the collection and analysis of all available information on locust movements at the Imperial Institute of Entomology in London, which has been recognised as the international centre for the collection and dissemination of information in regard to biological and systematic research on locusts by all the countries represented at the Conference. All countries and Colonies participating in the investigations have been asked to submit monthly reports on the locust situation accompanied by maps, and an appeal has been made to other countries interested in the locust problem to join the international scheme of research. Reports of this kind are now received from 28 foreign and 17 Empire territories and are summarised periodically at the international centre. The first summary representing a survey of the locust outbreak in Africa and Western Asia during the period 1925-1931 has been prepared, and was distributed early in 1933 to those interested in the problem.

The second main line of research consists of field investigations in various parts of Africa where breeding areas of locusts are known, or are suspected, to exist. The British programme of field work provides for three field entomologists in the Anglo-Egyptian Sudan and East Africa, while two entomologists of the Nigerian Government are working on the same problem in West Africa. Three entomologists are being sent by the French Government to French West and Equatorial Africa, and will work in close contact with the international centre at London, and with the British field entomologists. The cost of the French anti-locust organisation is entirely defrayed by contributions received from French African territories. The British investigations are financed partly from the Empire Marketing Fund and partly by contributions received from British Colonies and mandated territories and the Anglo-Egyptian Sudan.

The general direction and co-ordination of the investigations undertaken in different countries rest with the International Conference which it is proposed to hold annually, and the next (third) Conference will take place in London. At these Conferences the results already achieved and programmes of further work will be discussed by the specialists actually engaged in the research.

An interesting further development in the anti-locust campaign was suggested by the Economic Advisory Council's Committee on Locust Control in the early part of 1932, as the result of which a grant has been made on the recommendation of the Colonial Development Advisory Committee from the Colonial Development Fund to enable experiments to be carried out in Kenya in the discharge of clouds of poison dust from aircraft against flying swarms of locusts. A considerable amount of preparatory work of a technical character was found to be necessary, but it is understood that unless any unforeseen difficulty arises the experiments with aircraft will be carried out this summer.

Entomological Research in Australia

In last year's report reference was made to the proposal to breed up a stock of parasites of the buffalo-fly at the State Veterinary Institute at Buitenzorg in Java. Professor Handschin, who was in charge of this work, was able, by crossing the Javanese and the North Australian species of *Spalangia*, to develop a race of insects which is much longer lived than either of the progenitors, and which lays a greater number of eggs. Professor Handschin arrived in North Australia with a consignment of this race of *Spalangia* in April, 1932. These were bred in numbers and liberated near Darwin with a view to ascertaining whether the widespread use of this variety of insect would be of value in the control of the buffalo-fly. Preliminary reports indicate that the parasites appear to be doing fairly well. A report by Professor Handschin dealing with the results of the work in Java and Northern Australia and their possible application in preventing the spread of the fly has been published.*

Work on the control of the Sheep blowfly, which is the main entomological task of the Council for Scientific and Industrial Research, has been pressed forward under the direction of the special Blowfly Committee referred to in last year's Annual Report. A comprehensive report dealing with the existing state of knowledge and the scope of present and future investigations has been published.†

* "A Preliminary Report on Investigations on the Buffalo Fly and its Parasites in Java and Northern Australia." Pamphlet No. 31 of the Commonwealth Council for Scientific and Industrial Research, Melbourne, August, 1932.

† "The Sheep Blowfly Problem in Australia." Report No. 1 by the Joint Blowfly Committee appointed by the Council for Scientific and Industrial Research and the N.S.W. Department of Agriculture. Pamphlet No. 37 of the Commonwealth Council for Scientific and Industrial Research, Melbourne, January, 1933.

This report discusses all aspects of the problem such as biological control, dipping, trapping, breeding for resistance, etc.

Work has been continued during the year on the control of Termites (White Ants), apple thrips which feed in great numbers on apple blossom, the pine aphid which attacks exotic pines, and St. John's Wort, a weed whose rapid spread has caused considerable concern.

Close relationship is maintained between the Division of Economic Entomology of the Commonwealth Council for Scientific and Industrial Research and the Parasite Laboratory at Farnham Royal (*see* page 43). In connection with the work on St. John's Wort an Australian entomologist is attached to the Parasite Laboratory and his duties are to discover the varieties of insects which feed on the plant, work out their life histories, and test them on a selected list of economic plants to see that they cannot feed on any but their own food plant. When he is satisfied that an insect is specific in its feeding, he breeds it in numbers and ships it in a suitable stage to Australia. A Progress Report on this work has been published.*

MYCOLOGY AND PLANT PATHOLOGY

Virus Diseases of Plants

Rothamsted Experimental Station.—By the use of collodion membranes of known and graduated pore size, it has been found possible to determine, on the one hand, the size or pore through which a particular virus can pass, and on the other, the size which prevents it from passing. The pore sizes differ with different viruses, e.g. the virus of tobacco Mosaic just passes pores of 0.051μ , Aucuba Mosaic virus of tomato passes 0.112μ but not 0.1μ , a Hyoscyamus Mosaic virus passes 0.30μ but not 0.23μ . From these data it can be deduced that the sizes of the viruses, or perhaps of particles to which the viruses are attached, vary from $15 \mu\mu$ in tobacco Mosaic to $150 \mu\mu$ for the Hyoscyamus virus. The method allows, in some cases, of the separation of two viruses occurring mixed in nature.

A rapid and convenient method of determining the quantity of virus contained in a sample of plant juice has been developed by the use of a necrotic-spot technique, the number of spots varying directly

* "The Possibility of the Entomological Control of St. John's Wort in Australia. Progress Report." Pamphlet No. 29 of the Commonwealth Council for Scientific and Industrial Research. Melbourne, 1932.

with the concentration of virus. This is further evidence in support of the view that virus exists in a particular state, and not diffused throughout the liquid. For the first time a method has been discovered of producing in the living non-virus plant intracellular inclusions which are indistinguishable from those produced by virus. This consists in supplying the plant with a salt of molybdenum, and up to the present no other substance has been found to give the same results. The artificial lengthening of the day during the winter months, referred to in last year's Report (p. 49), continues to prove thoroughly satisfactory.

Experimental and Research Station, Cheshunt.—During 1932 tomato plants suffering from Spotted Wilt were received for the first time. They came from widely separated localities in Great Britain. The disease was studied and found to be identical with the Spotted Wilt of Australia, but distinct from the Mosaic and Stripe diseases of tomato of this country. Clean cultural methods and the eradication of Thrips are emphasised as control measures. There is a danger of the disease over-wintering in Dahlias and Chrysanthemums. Experiments with treatments calculated to improve infected plants have not given conclusive results, but some success has been obtained in nurseries by methods which increase the rate of vegetative growth. Two outbreaks in Cinerarias (Kent and Herts) have been examined.

Investigation of tomato diseases of the Mosaic, Stripe and Streak group has been continued. Ordinary or mild tomato Mosaic has been identified with true tobacco Mosaic and found not to be implicated in Stripe. The symptom-picture in the tomato which characterizes Stripe may be due to several causes. As the diseases are usually indistinguishable on tomato the term Stripe will doubtless be retained by growers, but the following more precise nomenclature is proposed:—the name stripe is suggested for use when the disease is attributed to *Bacillus Lathyri*; Glasshouse Streak when due to a single virus; while Streak, in conformity with American terminology, is reserved for a mixed virus infection (typically tomato Mosaic and potato Mosaic). The viruses involved have been described. It is of practical importance to know the type of infection in a given case, because, although Stripe and Glasshouse Streak respond to treatment with potash, Streak does not. Applications of nitrogenous compounds benefit plants affected with Streak.

Investigations of the effect of the virus of Aucuba Mosaic of tomato on the metabolism of affected plants from the time of inoculation up to the appearance of severe mottling have been continued. When healthy and also inoculated plants are examined immediately before and after 12 hours darkness, the amount of starch in the diseased plants is slightly greater than in the healthy plants. This holds good until the appearance of severe symptoms, when the amount of starch in the diseased plants is much less than in the healthy plants. The amount of reducing and non-reducing sugars in the diseased plants usually decreases during the night, whereas that in healthy plants increases. The total amounts of starch and sugar in the leaf (lamina and petiole) of diseased and healthy plants, sampled at three hourly periods throughout 24 hours, show marked differences; and, though several theories can be suggested to account for this, more work is necessary before a definite conclusion can be reached.

In view of the greater prevalence and severity of Mosaic disease of tomatoes in certain parts of one and the same house, investigations are in progress to determine the relation between soil conditions and the incidence and extent of tomato Mosaic.

Scottish Society for Research in Plant Breeding, Corstophine.—The investigations into the carbohydrate metabolism of potatoes affected with virus diseases has been continued. Those on the carbohydrate metabolism of Leaf-Roll and healthy potatoes were completed in 1931 and the results published.* That on the carbohydrate metabolism of Crinkle-infected plants was completed in 1932, and the results will be published shortly.

At the same time, the nitrogen side of metabolism has been studied and the work on healthy and Leaf-Roll potatoes has been completed. The results will shortly be available for publication. In brief it has been found that nitrogen metabolism in Leaf-Roll plants does not markedly differ from that in healthy ones, and Leaf-Roll is not a disease in which the nitrogen metabolism is distributed, as has hitherto been supposed.

The work at the Ainville Sub-Station consisted in the growing of plants in insect-proof greenhouses for seasonal analyses in the nitrogen work on Leaf-Roll.

* Trans. Roy. Soc. Edinburgh, Vol. LVII, No. 11.

Work at the Huntly Sub-Station has again been confined to the Mosaic diseases of potatoes. In 1932 an investigation was carried out on the carbohydrate metabolism of healthy potatoes and potatoes infected with the X and Y viruses of Smith and Salaman. The analytical side of this work has been completed; the data are being statistically examined and will be published in due course.

For the genetical side of the work, it has now been decided to carry out the actual crossings between the various varieties and also between healthy and diseased plants at the Corstophine Station, and a programme has been arranged for 1933. Resistance tests with possible commercial varieties having a high resistance to or tolerance of virus diseases will also be carried out at Corstophine. Seedling progenies will now be grown entirely at Huntly, and a start is being made with seed obtained from various crosses made at Corstophine in 1932.

Albert Agricultural College, Glasnevin, Dublin.—With a view to reducing the confusion arising from the description of the same virus under different names, an account was prepared and published of a comparison of some European and American virus diseases of the potato.* Four of these diseases were found to be identical, and a number of others probably so. The "Wilding" condition was proved to be of virus origin, and to be equivalent to "Witch's Broom". Simple Mosaic was found to be very common in American potatoes, and to be identical in all probability with the "Healthy" potato virus.

Reference was made in last year's Report to the need for a proper understanding of the nature of virus complexes and their constituents. Work was continued on this question with particular reference to the Crinkle complex, the compound nature of which (unlike that of many supposed virus complexes) was readily shown by analysis and by synthesis in the potato. The constituent viruses, namely virus A and a simple Mosaic virus, were isolated by means of *Myzus persicae* and by needle, respectively, as well as by the use of differential hosts; they were then recombined in various ways, with the production of the original Crinkle in each case. A study of the isolated viruses showed that the aphid-borne virus produced typical symptoms of

* "A Comparison of some European and American Virus Diseases of the Potato," by Paul A. Murphy and Robert McKay, *Sc. Proc. R. Dublin Soc.*, 20 (N.S.). 1932. pp. 347-358.

vein-clearing and vein-banding on tobacco, thus corresponding in this respect to the virus Y, lately described by K. M. Smith ; but it differed markedly from the latter in its reaction on potato varieties. The needle-borne virus was found to be a simple Mosaic virus, corresponding in part to virus X as described by the same author ; but it passed through *Petunia* unchanged. There was no evidence of the presence of a third virus.

Although further proof was thus afforded of the presence of two viruses in Crinkle, no evidence of a dual nature was found in simple Mosaic, Interveinal Mosaic, or the Streak normally occurring in Up-to-Date. These three diseases were passed by needle through *Datura Stramonium* and returned to potato with the production in it of the original disease in each case. Particular attention was paid to Interveinal Mosaic, and in all cases it behaved as an entity and was recovered unchanged in potato from a number of other hosts. The common Streak disease of Up-to-Date was found to be an acronecrotic disease, and the corresponding virus was filterable and transmissible by needle, but not by *Muzus persicae*. One of the first effects of Streak and Crinkle on potato foliage was found to be the accumulation of starch in certain cells.

A paper is in course of preparation embodying the foregoing results, and presenting an interpretation of them in the light of previous results from this and other laboratories.

Cotton Disease Research

The work at the Rothamsted Experimental Station on the Angular Leaf-Spot or Blackarm disease of cotton, which has been assisted for four years by the Board, has been brought to a conclusion on the departure of Dr. Stoughton from Rothamsted.

The work on the influence of environmental conditions on the disease, which has been carried out in the special control chambers erected under a grant from the Empire Marketing Board, has led to a number of definite conclusions. The results of six years' work on this aspect of the disease may be briefly summarized :—

Primary infection of the cotyledon is usually due to bacteria carried on the outside of the seed and in the fuzz. Thorough disinfection of the exterior of the seed results in healthy seedlings.

Soil temperature affects the amount of primary infection, a constant soil temperature above 30° C. reducing the degree of

infection, but infection is not inhibited at 40° C. A regular diurnal variation in soil temperature produces the same effect on infection as a constant temperature near to the mean of the fluctuations. Soil temperature is of importance as regards the disease only during the first two or three days after sowing. A high soil moisture content favours the primary infection. Primary infection is affected by the type of soil in which the plants are grown. Soil temperature has little or no effect on secondary infection resulting from spray inoculation of the plants. Plants diseased in the seedling stage grow out free from disease if no further inoculation occurs.

Air temperature has a marked effect on secondary infection. Maximum infection occurs at a constant air temperature of 35-38° C., with decreasing incidence at progressively lower temperature. A regular diurnal variation in air temperature exerts an effect on the amount of disease equivalent to that of a constant near to the mean of the fluctuations. Experiments on abrupt changes of temperature show that air temperature is of importance throughout the incubation period of the disease ; the actual temperature at the time of inoculation is comparatively unimportant, except in so far as it affects the mean temperature during the incubation period. The amount of infection at a given temperature, or mean equivalent temperature, is conditioned by the atmospheric humidity at the time of inoculation. High humidities favour infection, low humidities reduce it. Humidity is of importance only during the first two days after inoculation.

PLANT BREEDING

Welsh Plant Breeding Station, Aberystwyth

In the spring of 1932 the seed of seven pedigree strains of grasses were released to the trade for multiplication. These included one strain of cocksfoot, four of timothy, one of rye-grass, and one of red fescue.

Forty acres of pedigree grasses and clover were harvested during the year 1932, and eighteen additional acres were sown down. In all, the seed from thirty strains, eighteen of grasses and twelve of clovers, were grown in ten counties by thirty-three growers. The main bulk of the seed was produced in two districts, namely, the Welshpool

district and in the Wye Valley. The first multiplication of new red clover strains on the other hand was chiefly conducted in non-arable districts, such as the Towy Valley. Harvesting conditions were favourable on the whole, and the quality of the seed appears to be as high as any imported from the best seed growing countries. Two pedigree strains of red clover were carried to the second multiplication stage by the sowing out of three acres, which will be harvested for seed in 1933.

Further progress has been made with a view to the better understanding of the proper methods for growing remunerative seed crops on a field scale as applied to different types of pedigree grasses. Two aims have been kept constantly in view—

- (a) to increase the yield of seed and
- (b) to reduce the cost of production.

Problems peculiar to indigenous grasses in connection with the dressing of their seeds have been investigated and appropriate machinery has been designed to overcome various difficulties.

Preliminary studies have been initiated by resort to a new technique with a view to measuring the efficiency of distance isolation for seed production in the case of both cross-fertile grasses and clovers.

The work on delayed establishment in some species of grasses is being continued and important results from these investigations have been published. Arising out of this work an investigation has been commenced into the relations between the mineral nutrition of grass-seedlings and their reaction to diminished illumination.

A detailed study has been made of the exact manner in which soaking the "seeds" of cocksfoot in water causes an acceleration of germination. It is hoped to publish this work in the immediate future.

Further experiments are being conducted on the germination of grass "seeds" in solutions of cane sugar ("suction-force" determinations) but little material is available that is suitable for this purpose.

The work on peaty hill soils is continuing ; it is probable, however, that another season's growth will be required (making three years' growth in all) before a definite account of the results can be provided.

The investigations which have been in progress for some time on occurrence of buried weed seeds in the soil underlying pastures of various types have been continued and a report on the first batch of fields investigated will be published at an early date.

Last year's report referred to the visit to Australia of Mr. William Davies, the Empire Grassland Officer, at the invitation of the Commonwealth Council for Scientific and Industrial Research and the Australian Dairy Council. Mr. Davies returned to England in December after a year's stay in Australia. He was able to give valuable advice on problems of grassland research now in progress in the Commonwealth, and the Council for Scientific and Industrial Research are convinced that immense good will result from this visit, which has been in part responsible for the extraordinary growth of interest in Australia in the problems of pastures and pasture management. Mr. Davies' report will probably be published in the Board's "Grey Book" series of reports.

Mr. Davies took the opportunity of returning home via New Zealand so that he could spend a month in that Dominion studying the progress of the work at the Plant Breeding Station at Palmerston North which he helped to start in 1929 and 1930.

Plant Research Station, Palmerston North, New Zealand

The activities of this Station have been well maintained and marked progress has been made during the year, particularly in regard to the value of strain influences in grasses and clovers, and in the control of several serious diseases of farm crops, all of which may result in marked improvements in the financial returns from farming.

In the Agronomy Section the certification of seeds was extended during the 1931-32 season to include cocksfoot, Montgomery red clover, and Kentish wild white clover. Other crops subject to certification are New Zealand white clover, perennial rye grass, potatoes, brown-top, wheat and beans.

In the Agrostology Section the main work has been the improvement of strain in pasture plants and the aim is the rapid reproduction on a commercial scale of lines that are by test up to pedigree standard. Strain trials have been in progress with perennial rye-grass, cocksfoot, brown-top, timothy, white and red clovers, and other species. The trials with rye-grass during the past three years have resulted in a type which is giving eminent satisfaction wherever it is being grown

and which stands out markedly superior to the poorer types which dominated the markets before strain and certification work were initiated in New Zealand. One half of a crop of seed harvested from a line of British seed supplied by the Welsh Plant Breeding Station at Aberystwyth has been returned to the Welsh Station for comparison with the original mother seed supplied. Similarly, as a result of trials of New Zealand and Aberystwyth lines of cocksfoot, part of the seed obtained from the Aberystwyth crop will be returned to Wales for comparison. This part of the work forms an excellent example of Empire co-operation in research.

The Field Experiments Section deals with research into fundamental grassland problems, investigations and demonstrations by field officers, and experiments on annual crops. Six lines of investigation have been in progress to test the effect on pasture production of different manurial applications. Grazing trials on dairy farms have been maintained to determine the effects of nitrogenous fertilizers and of different types of rye-grass, and observations are being kept to discover the response of grasslands to lime, phosphate, potash and nitrogen. Work on annual crops has consisted of manuring experiments with wheat, oats, barley, potatoes, swedes and turnips; wheat and potato variety trials, and variety trials of swedes and turnips to determine their resistance to club-root disease.

The Mycology Section has concentrated on club-root and dry-rot diseases of swedes and turnips, virus and other diseases of potatoes, collar-rot of peas, bean wilt and other legume diseases, barley smut and oat rust, cheese moulds and forest tree diseases. Resistant strains of swedes and turnips have been grown on infected soil. From these, apparently immune plants were selected and seeded and the seed sown in infected soil again for further immunity trials. Experiments on dry-rot have led to the production of a seed disinfection method which proved effective when tested with seeds from a line averaging about 15 per cent. infection and when field areas were sown with seed treated by the process.

The Imperial Institute of Entomology, through the Parasite Laboratory at Farnham Royal, has co-operated with the Entomology Section of the New Zealand Station in the control of the Cabbage White Butterfly. Well known parasites of the pest occur in Britain, and collections made at the Parasite Laboratory were shipped to

New Zealand where they will be reared and liberated. The life-history of the Red Mite has been completed and a study has been made of the seasonal history of the codlin moth. Laboratory and field experiments on the efficiency of various sprays for insect control have also been carried out.

The Herbarium, under the control of the Botany Section, now contains over 7,500 specimens of indigenous and introduced species, and over 4,000 specimens of foreign plants. The latter are important for research on introduced flora. Systematic botanical identification of species of farm economic plants is continuing and co-operation is being maintained with the Royal Botanic Gardens, Kew, in the general systematics of the New Zealand flora.

The work of other sections of the Station has similarly shown good progress.

Division of Plant Industry, Commonwealth Council for Scientific and Industrial Research

The Division's Plant House at Canberra, referred to in last year's report, has now been completed.

A junior Plant Physiologist was appointed during the year from the grant made available by the Board. He will assist the senior Plant Pathologist of the Division on fruit work in Tasmania with special reference to bitter pit and other pathological conditions of apples.

Another junior Plant Physiologist has been appointed to assist in work on wheat problems in Canberra with special reference to the four problems of flag smut, root rots, drought resistance and yield.

Considerable attention has been given to the lines on which plant introduction and allied agrostological work might best be developed in the future. Already more than a thousand introductions have been made and varieties have been tested for yield, seed production, etc. Several promising grasses have thus been found. An important piece of work that is being undertaken consists of the collection of data on which to divide Australia into broad grassland zones. The resultant map and other information will be of considerable value not only in connection with the testing of promising introductions but in several other directions.

HORTICULTURE

East Malling Research Station, Kent

The interest stimulated in rootstock problems by the Director's tour in 1930-31 has continued to bear fruit. In those countries where the immune Northern Spy rootstock for apples is used (Australia, South Africa and New Zealand) there is an ever increasing volume of evidence which suggests that, where any limiting environmental factors are present, trees on this stock are of very poor performance. Yet amidst these poor plantations are to be found a few trees on unknown (probably seedling) stocks thriving well. In some cases methods of renovation of poor plantations on Spy are already in full swing and showing quite striking results. Vigorous root systems are being inarched into the stems of the unthrifty trees with definite and comparatively quick results. East Malling is being kept in touch with and consulted upon the application of such methods. Dr. Allan and Dr. Cunningham, working upon the classification of Spy stocks, have already reported from New Zealand the isolation by botanical and pomological characters of some nine varieties showing a wide range of vigour.

During the present season some 26,000 rootstocks, as well as several sets of budded trees, have gone out from East Malling for experimental purposes to the Dominions and India. Some 1,000 trees of Mackintosh Red and Fameuse are now ready in the East Malling nurseries, upon both layered and selected seedling roots, to test out, in collaboration with the Dominion Horticultural Experimental Farms, the behaviour of these trees in Eastern and Western Canada. Whilst it is not claimed that any of the East Malling stocks already in circulation are immune from Woolly Aphis, it is emphasised that they are no more susceptible than seedling stocks (which are rapidly coming back into use) and far less variable. Their potentialities are known.

The Nursery Trade at home has absorbed over 200,000 rootstocks this season.

The exchange of workers between Summerland, British Columbia, and East Malling carried the propagation side of the rootstock problem a stage further. Mr. R. C. Palmer, of British Columbia, carried out some intensive nursery trials at East Malling with root cuttings in collaboration with the Statistical Section, and Mr. W. S. Rogers, of East Malling, whilst in Canada, was able to overcome

propagation difficulties previously encountered there by suggesting modifications of layering methods in order to adapt them to local conditions. This interchange of investigators has proved mutually beneficial in many other ways. Mr. Palmer was able to set East Malling on the right lines for establishing a technique for testing the optimum time of picking of apples and pears—an aspect neglected in this country. Again, the studies of root growth and development as initiated by Mr. Rogers in collaboration with the Pathologists at Summerland, using similar technique in such widely differing conditions as Kent and British Columbia, have already proved of great interest; and comparison of the results, made possible by the exchange of the actual workers, will add considerably to the value of each individual experiment as it develops further. The observation trenches which were established at Summerland appear to be a hopeful line of attack on the serious tree losses caused by root troubles. They should also be of assistance in the testing out of more resistant rootstocks as they are selected or bred.

The soil moisture recording instrument is still in process of development and offers a further aid to the study of soil and root problems. Finally, a fairly complete survey of the root investigation work on the Continent of America has been made, thus carrying a step forward the expressed wish of the Imperial Agricultural Research Conference of 1927 for the presentation of a resumé of this subject.

The breeding and testing of a wide range of Woolly Aphis immune apple stocks, in collaboration with a geneticist at the John Innes Horticultural Institution, Merton, have been greatly accelerated. Approximately 1,000 seedlings can now be tested annually, and some of the more recent crosses promise to give a proportion of immune material as high as 50 per cent. from which to select. As soon as their immunity under English conditions is assured, consignments are sent to entomologists overseas to retest them under widely different environmental conditions. Samples have already gone to Canada, whence the initial reports are encouraging, to New Zealand and India. It is hoped to send further consignments to South Africa and Australia.

The most significant feature of the past year for the Statistical Section has been the growing interest in the technique for field experiments in horticulture which has been built up. This interest is not confined to the layout and interpretation of trials but extends

to the actual methods by which the results of these trials are measured; and it is worthy of note that the contacts which have been established are not only with research workers who deal with deciduous fruits, but include those in many different parts of the Empire working with all kinds of horticultural plants. Several field trials have been planned including apple manurial trials in New Zealand, a raspberry manurial trial in Canada, citrus manurial trials in South Africa and Tanganyika, coffee experiments in Kenya and Uganda, and an extensive series of cacao experiments in Trinidad. Professor Clark Powell, of South Africa, has furnished crop records in connection with the manurial trials of citrus, which have made it possible to study the variation to be expected in this crop in commercial plantations under South African conditions. This should be of value in the layout of future experiments. Many workers have made personal visits to the Station either to familiarise themselves with the arrangement of field experiments and the simple statistical processes whereby the results are analysed, or to study the conduct of such experiments in the field. Others have brought particular problems, the discussion of which has proved mutually of great interest. The problem most frequently encountered is the difficulty of experiments with variable material, such as is found with most tropical fruit plants. Particular attention has, therefore, been focussed on this problem.

The technique for leaf measurement, developed in work on young trees, has been successfully applied by the Physiological Section to the measurement of the leaves on two nine year old apple trees. This work was carried out in collaboration with Dr. H. Evans who studied at East Malling before taking up his appointment as Physiological Botanist to the Mauritius Sugar Research Station. The results are being used to develop a technique of sampling whereby the leaf relations of trees under different manurial or pruning treatments or on different stocks can be compared, so as to determine whether these factors bring about their characteristic effects on tree performance by altering the leaf relations of the trees and whether these effects can be foretold at an early stage by measurements made on the leaves.

Injection methods have been evolved in the Biochemical Section for treating either a whole tree or any portion of it, from a main branch to a twig. These methods are being applied not only to testing the effects of the various elements which analysis has shown to be of

interest in the rootstock-scion problem, but also as a quick and cheap method for revealing nutritional deficiencies in commercial orchards. The methods seem likely to be applicable to many other trees, bushes and plants grown in various parts of the Empire. Mr. L. A. Thomas, of Australia, who has been awarded the studentship created by the Trustees of the Commonwealth Science and Industry Endowment Fund (*see* last year's Report, p. 59) is, during his year's study at East Malling, applying the methods to young trees preparatory to working on commercial orchards showing deficiency symptoms in the Stanthorpe District of Queensland.

Considerable progress has been made by the Pathological Sections in collaboration with the Pomologists in demonstrating practical methods for the establishment of healthy clonal races of Raspberries and Strawberries. A year ago a series of special raspberry nurseries was developed on the Farm Institutes in Kent and Sussex and with selected growers for the propagation on a commercial scale of cane free from mosaic disease. These nurseries were laid out on the basis of information about the disease accumulated in previous years with material from a clonal mother plot at East Malling. Inspections of the nurseries during the year have shown that a very satisfactory control of this all important widespread disease has been maintained at very little cost. Already applications for cane from these nurseries and from the parent nursery at the Research Station have been received from all parts of the home country, from the Irish Free State and from Canada.

A further series of experiments on the causes of a certain form of Strawberry "degeneration" has established the existence, at least in this country, of a virus disease which causes a rapid loss of vigour leading to the sterility and death of infected plants and their runner progeny. A review of the previous work on the chief "degeneration" diseases at home and overseas has been prepared and is being handed over to the Imperial Bureau of Fruit Production for circulation overseas. Investigation of measures for the commercial control of the disease, the multiplication of healthy clones and the selection of optimum runners has been inaugurated.

The Entomological Section has been following up the relation of the important Tarsonemid Mite of the Strawberry to the above-mentioned disease in conjunction with which it is so commonly found. These investigations have been co-ordinated with work by the Entomological Department in Ottawa.

In collaboration with Entomologists in India and the Sudan, the study of certain species of gall mites, which occur on plants of economic importance, has progressed, and a new species from South India has been described.

An exchange of workers investigating the diseases of small fruits has now been arranged between Dr. G. H. Berkeley of the St. Catharine's Field Laboratory of Plant Pathology in Ontario, and Mr. R. V. Harris of the Department of Plant Pathology at East Malling.

During the year the Technical Officer has received, in conjunction with the Imperial Bureau of Fruit Production, some 70 overseas visitors from all parts of the Empire. Of this total no less than 11 have made extended visits varying from a few days to several weeks or months under the facilities offered to Post Graduates.

Owing to the general desire expressed by applicants under this Scheme to use their study period as preparation for higher degrees, representations were made to the University of London, with the result that the Station has now been recognised as an Institution at which students may work under recognised teachers as candidates for higher degrees.

Long Ashton Agricultural and Horticultural Research Station

In last year's report a summary was given of the more important facts which had emerged from fruit storage experiments and chemical studies. It was shown that several generalisations could be made regarding the effects of orchard factors on storage qualities and chemical characters, and the relationships which exist between storage properties and chemical features were also indicated.

During the past year, the programme of storage experiments and chemical investigations was continued along similar lines with a view to checking previous results under different seasonal conditions and with fruit obtained from various fruit growing centres. The results of this further work are wholly in agreement with those already reported and need not again be stated in detail. They have been summarised in a paper read before the Horticultural Education Association in September, 1932.

A special feature of the year was the comparison of the storage qualities of a number of samples of plums, variety Yellow Pershore,

from plantations of light and heavy soils in the Evesham-Pershore area. This experiment has now been carried out during a wet and a dry season, and the results have confirmed the practical experience of growers that better quality plums are produced on the heavy soils in dry season and on the light soils in wet years. Three branches of the investigations have yielded results of particular interest during the year, and these are outlined below.

Soil Moisture Experiments.—The initial object of these experiments is to determine whether soil moisture is of importance in the problem of Bitter Pit in apples. Two series of apple trees are grown in pots under high and low soil moisture conditions respectively and housed in a specially designed glass orchard house to protect the trees from rain. Under these conditions, it was possible in previous seasons to obtain crops of fruits from the high moisture series which developed large percentages of Bitter Pit in store, but crops from the low moisture treatment were too small for critical storage tests.

During 1932, a series of heat waves occurred which resulted in very high temperatures in the glass shelter. As a result, severe outbreaks of "Cork" and Water Core occurred almost immediately, and after picking a large proportion of the sound fruits developed Bitter Pit. Cork troubles were much more prevalent and severe in the high moisture series than in the series under the low moisture treatment, the percentages of the total crops showing injury at harvesting being High Moisture 60·9 per cent. and Low Moisture 26·2 per cent. The results indicate that high temperature is probably the most potent factor in the development of Cork, Water Core and Bitter Pit but that soil moisture may also play an important rôle.

The experimental technique has been modified to enable the temperature—soil moisture relationships to be further examined.

Physiological Investigations.—The results obtained in the storage experiments and chemical investigations have suggested the importance of "maturity" in connection with the effects of certain orchard and pre-storage conditions on storage qualities. Following these indications, extensive investigations have been carried out with a view to examining maturation processes previous to harvesting on the tree and after picking in store, and in an attempt to relate the effects of the orchard factors, grass and arable culture, potassium deficiency, fruit thinning and bark ringing to these processes. In

studying maturation, the rate of softening of the fruits, the distribution and disappearance of starch and the changes which occur in nitrogen, acid and sugars have been followed. An attempt has been made to correlate the ripening phenomena with the supplies of food available to the fruits, but the facts only partly fit the working hypothesis that favourable food supplies delay maturation processes.

Preliminary investigations had shown that terminal and lateral fruits show special characters as regards shape, flavour and texture, laterals appearing to possess superior dessert properties. Detailed comparisons with apples, involving chemical and storage investigations, have been made between the two types of fruit under the orchard conditions of "fruit thinning" and "no thinning" treatments. No difference was found between the susceptibility of the two classes of fruits to storage "breakdowns" but with certain varieties, such as Allington Pippin, terminals were found to be much more susceptible to storage rots. Laterals contained higher amounts of dry matter and cane sugar than terminals at picking time where crops were not thinned, but thinning raised the contents of these in both types of fruit and in the thinned crops the cane sugar contents were not significantly different. During storage, laterals lost both dry matter and cane sugar more rapidly than terminals so that differences which exist at picking time tend to disappear during storage.

Vitamin C Content of Apples.—In these experiments, which have been carried out in collaboration with Dr. S. S. Zilva of the Lister Institute, attempts have been made to alter the content of vitamin C by certain cultural practices. Using the varieties Bramley's Seedling, which is relatively rich in the vitamin, and King Edward VII, which has an especially low vitamin content, it has been found possible to increase the vitamin content significantly in every case, and by as much as 100 per cent. in certain instances, by reducing the nitrogen content of the fruits by means of grass culture and bark ringing. No difference in vitamin content was found between large and small apples graded out from a single crop. The results will be published shortly.

Fruit Research in New Zealand

The programme of fruit research in New Zealand, which is co-ordinated with the work of the Plant Research Station at Palmerston North, the Cawthron Institute at Nelson, the Horticulture Division,

the Cambridge Low Temperature Research Station, and the East Malling Fruit Research Station in Kent, has enabled a wide sphere of activity to be covered. The research orchard at Appleby is now being fully utilized for a comprehensive series of manurial and spraying trials, while detailed information regarding the yields of each tree is being accumulated in order that the basis of all future experimental work may be sound. Marked advances have been made in the knowledge of fruit-tree sprays during the year, and this is of such a nature that it can be used in the direction of improved orchard practices almost immediately. Rootstock investigations and manurial trials have been inaugurated which will provide ultimately long-range results which will yield important fundamental knowledge to the fruit industry. Steady progress has been made in the study of the more serious insect and fungus pests affecting orchardists. An extensive series of transport and cold-storage trials has been maintained, so that it has been possible to trace the effect of the many influences which play a part in the causation of fruit-wastage. The attention devoted in the past to problems of fruit cold storage and transport has been in large measure responsible for the high standard of quality in which it is now placed on oversea markets.

Tulip Growing Experiments in Malta, Cyprus and Palestine

Following a suggestion made by the Director of the John Innes Horticultural Institution, the Board arranged with the Governments of Malta, Cyprus and Palestine for experiments in tulip growing to be carried out in the three countries during the past winter and spring. It is thought that the warm soil and climatic conditions of these countries may result in the production of bulbs specially suited for forcing purposes. At present such bulbs are imported in large quantities from Holland, where they are raised in artificially heated soil. A generous gift of nine thousand tulip bulbs was made through the Board for the purpose of these experiments by Mr. George Monro, of Covent Garden. When the trials are concluded the bulbs will be returned for examination by tulip forcing experts in this country.

ECONOMIC BOTANY

Royal Botanic Gardens, Kew

The Board's grants to the Royal Botanic Gardens, Kew, have been devoted to the appointment of Mr. H. C. Sampson as Economic Botanist, to the employment of Plant Collectors, and to the speeding

up of the work of classifying herbarium material. These grants have enabled Kew to provide services of great importance to the development of the botanical and agricultural resources of the Empire, and to fulfil more effectively its functions as an Empire centre for botanical work.

There is no doubt that the work of the Economic Botanist has resulted in closer co-operation between the Colonial Empire and Kew. One of the first essentials was for the Economic Botanist to obtain an appreciation of local conditions and to effect a personal liaison with the staffs of Agricultural Departments. The visits made by Mr. Sampson to the West Indies, British Guiana, British Honduras, the Bahamas, Bermuda, and the West African Colonies, combined with his previous experience in India, Malaya, Ceylon and South and East Africa, have specially equipped him to visualise the needs of different parts of the Colonial Empire.

Special mention should be made of the comprehensive inventory of the economic crops of sub-tropical and tropical parts of the Empire, undertaken by the Economic Botanist as a result of a Resolution passed at the Conference of Colonial Directors of Agriculture held in July, 1931. Even in its present incomplete state, this work has proved of value, but the inventory itself is, it is hoped, only the preliminary to more intensive investigations on staple food—and export—crops. When it is considered that nothing of this nature has ever been attempted before, the potentialities of the work for the improvement of crop-production in the Empire are obvious. It is unnecessary to emphasise the beneficial effect of such improvement on the general economic conditions of the Empire as a whole.

That the widened sphere of usefulness of Kew is appreciated is shown not only by the great increase in correspondence, with the Colonies in particular, but by the greatly increased number of botanical specimens received for identification and for information as to their economic value. Kew is now able to give prompt and adequate attention to enquiries and requests for identification. The specimens sent to Kew annually during the last few years are almost five times greater than they were ten years ago, while last year, 140,000 sheets were received. All these specimens have to be prepared, mounted and critically examined before they can be incorporated in the Kew collections. In many cases new species

may be represented, or the collections may include a large number of plants from one or other of the Colonies on whose Floras the botanists at Kew are engaged.

One botanist is engaged in writing a Flora of British Guiana, which has long been needed; another is working out the grasses of tropical Africa to complete the Flora of that region; and a third, following visits to Southern and Northern Rhodesia, is working on a Flora of Rhodesia.

The period for which the Board's grants were approved expired on the 31st March, 1933, but economical administration resulted in an unexpended balance being available at that date. The Board, impressed with the need for maintaining these services, has agreed to continue its support of the work till September, 1933.

DIETETICS

Research in the Vitamin Content of Fruits, Vegetables and Dairy Produce

As mentioned in last year's Report, the Board agreed that the unexpended balance of its five years' grant to the Medical Research Council for vitamin research at the Lister Institute might be used for continuing the work. The full grant became exhausted at the 31st March, 1933.

During the year the Report on Australian, New Zealand and English butters has been published.* This deals with the effects upon the vitamin content of different methods of preparation, transport and storage. It demonstrates that butters imported from Australia and New Zealand show a high and uniform potency in vitamins A and D, and that they are equal in this respect to the best summer butters produced at home. This finding is the more important in that these butters from the southern hemisphere are available in the English winter when the vitamin content of milk and butter produced in northern latitudes falls below its summer level. The report also shows that the fat-soluble vitamins in butter have great stability in cold storage.

* "Vitamin Content of Australian, New Zealand and English Butters," by M. E. F. Crawford, E. O. V. Perry and S. S. Zilva. Medical Research Council Special Report Series No. 175. Published by H.M. Stationery Office (price 1s.).

TROPICAL RESEARCH STATIONS

Imperial College of Tropical Agriculture, Trinidad

The Board has approved a grant of £14,400 as a grant in aid of the maintenance of the College during the year ending the 31st August, 1933.

The College is the recognised centre for post-graduate training in tropical agriculture for the agricultural services of the Colonial Empire. The total number of students in residence during the year 1931-32 was forty-five, of which twenty-five took the post-graduate course. Of these, twenty were Colonial Office scholars, two were Empire Cotton Growing Corporation students, one was an officer of the Gold Coast Department of Agriculture, and two were from Siam and Ceylon respectively, the latter being a Government scholar.

In addition to providing courses of study, the College has pursued long-range research in agriculture, botany, chemistry and soil science, and economics and on tropical crops. An account of research work on bananas and other tropical products is given on pp. 20 and 21 of this Report.

The Governing Body have long had before them the importance of building up a substantial Endowment Fund. A donation of £32,000 towards this object has been received from the Carnegie Corporation.

East African Agricultural Research Station, Amani, Tanganyika Territory

Research work of wide application to agricultural problems in the East African Territories continues to be carried out by this Station. Work on the rooting habits of *Coffea arabica* is producing results which may be of considerable importance to the coffee industry of East Africa. Important results have been secured from the investigations of the Pathologist, in co-operation with the Mycologist of the Department of Agriculture of Nyasaland, and it is hoped that control measures for the "yellows" disease of tea will now be effective. The Plant Pathologist is performing valuable work, particularly in connection with the white fly vector which transmits various diseases of maize, and has started investigations of the rosette disease of groundnuts and the mosaic disease of cassava. The Biochemist and the Plant Physiologist are attacking problems of

importance to plantation crops, and the Geneticist has made good progress in crop improvement studies for coffee and sisal. A programme has been drawn up for an investigation by the Entomologist into the ecology of insect pests of coffee.

The Board has agreed to continue its support of the Station's work till September, 1933.

SUGAR

Sugar Research in the West Indian Area

It has been possible for the Board to give effect in part to the recommendations of the Imperial Sugar Cane Research Conference of 1931. That Conference recommended (i) the establishment of a Central Cane Breeding Station in Barbados and of a Central Quarantine Station in Trinidad for introduced plant material ; (ii) the continuance of the cane breeding work in British Guiana previously assisted for one year by the Board ; and (iii) soil, ecological and entomological investigations in connection with the estate cultivation of sugar cane and investigations in connection with cane farming in Trinidad.

Barbados.—A scheme setting out in detail the organisation of and estimated expenditure for working the proposed Central Cane Breeding Station was drawn up in June, 1932, by the Agricultural Department in Barbados in consultation with the Agricultural Adviser to the Secretary of State for the Colonies, who was then visiting the Colony. This was submitted to the Empire Marketing Board which approved a maintenance grant for one year, with an additional grant for capital expenditure to be incurred during that year, to assist the conversion and extension of the present work on sugar cane breeding in Barbados into a central cane breeding station.

Trinidad.—A capital grant to the Government of Trinidad from the Colonial Development Fund has enabled effect to be given to the recommendation in favour of a Central Quarantine Station in Trinidad. The work which the Sugar Conference recommended should be initiated in Trinidad in connection with soil, ecological and entomological problems associated with estate cultivation and cane farming investigations has been made possible by a maintenance grant from the Empire Marketing Board to the programme of work drawn up by the Sugar-cane Investigation Committee which is financed by funds contributed by the Trinidad Government and the sugar planters and manufacturers of the Colony.

British Guiana.—A further grant for one year was approved by the Board in June, 1932, as a contribution to continued and extended work by the Colony's Sugar Experiment Station at Sophia on the breeding of improved varieties of sugar cane.

Sugar Research in Mauritius

The Physiological Botanist appointed to the Mauritius Sugar Research Station, who underwent a special course in applied plant physiology at the East Malling Fruit Research Station before proceeding to the Colony (see p. 63), assumed his duties in April, 1932, when the staff at the Station was brought up to full strength for the first time since its opening.

Good progress has been made with the cane breeding programme under the Senior Geneticist. The main object is the production, by modern methods, of high-yielding, disease-resistant hybrid seedling canes to replace the old varieties which are now proving inefficient when judged in the light of recent results obtained elsewhere, notably in Java. Over 125,000 hybrid seedlings were produced in the first two seasons. The first (1930) year's seedlings, planted out in 1931, have matured and much time has been devoted to the study and selection of seedlings in the field. Several crosses already promise to prove vigorous and resistant cane types. Trials on the resistance of seedlings of various crosses to Gummy Disease are beginning to yield results which will be of value in indicating what crosses to avoid when breeding for resistance to Gummosis.

The work of the Biochemical Division has been concerned with soil analysis and analytical methods, a soil survey to define the approximate limits of the various soil types, manurial experiments on estates to determine the optimum quantities of nitrogen, phosphatic or potassic fertilisers to be applied to virgin canes, a study of the organic content of the Mauritius soils and the optimum conditions needed for nitrification, a study of moisture relationship in the soil, and the analysis of cane juice with a view to determining the deficiencies of mineral elements in the soil.

The Physiological Division's main programme is the investigation of the course of growth in an important sugar-cane variety throughout the seasons, the analysis of the root systems of important varieties, and the study of root growth throughout the season. Other work planned for the future includes the study of the rooting systems of the

“ Big Tanna ” (the standard sugar-cane grown in Mauritius) and P.O.J.2878 (the celebrated Java variety), an analysis of growth rate experiment figures for the same varieties, further trials with nutrient and disinfectant media for the preservation of cut arrows used in cane breeding work and further trials to discover the best methods for rooting canes, and a study of methods for propagating cuttings, and for identifying cane varieties.

TEA

Tea Research in India

In 1929 the Board, on the recommendation of the Imperial Council of Agricultural Research for India, approved a capital grant to the Indian Tea Association towards the cost of establishing at Tocklai a laboratory of plant physiology and a five years' maintenance grant towards the development of research on problems connected with the constitution and composition of the tea plant.

Observations have been made and measurements taken of the growth of leaves, internodes and buds of numerous tea shoots. The rate at which new leaves are unfolded from the bud has been studied and experiments have been made on the ascent of sap in tea shoots. The recognition of different types of *banjhi* buds (i.e. stunted buds from which, as a rule, no further growth of flush can be looked for) during different seasons is an important advance towards an understanding of “ banjhi-ness.” A satisfactory method has been found for fixing and microscopically examining tannins in the tissues of the tea plant. Data in regard to leaf production and observations relating to propagation have been collected, and the work as a whole is enabling reliable conclusions to be drawn of considerable value to the industry.

TOBACCO

Tobacco Research in Southern Rhodesia

The scheme of investigation drawn up by the Southern Rhodesian Government for the Tobacco Research Station at Marandellas was outlined in last year's Report. This has now got well under way and it is hoped that the development of the Station's programme will yield results which may throw light on problems in other tobacco producing countries of the Empire.

General

In accordance with the recommendations of the Imperial Economic Committee in its Report on Tobacco, the Empire Marketing Board in February and May, 1930, convened Conferences at which the question of the interchange of information was discussed. In 1931, Mr. D. D. Brown, the Chief Tobacco Expert of Southern Rhodesia, visited the United Kingdom at the Board's invitation to discuss his Government's scheme for a Tobacco Research Station at Marandellas and at a further meeting, which Mr. Brown attended, the need for co-operation in tobacco research was specially discussed.

Following these preliminary discussions and subsequent consultation with the Imperial Institute, Government and producers' representatives and the Imperial Tobacco Company, the Board, in December, 1932, issued a circular letter to all tobacco producing countries of the Empire forwarding two memoranda prepared by the Imperial Institute, one indicating the main problems requiring investigation and the other the scope of the Institute's work on tobacco problems. A summary was also enclosed of the scheme of work at the Marandellas Research Station in Southern Rhodesia. These memoranda set out the facilities provided by the Imperial Institute as a clearing house of information on tobacco, and were designed to encourage co-operation in tobacco research among the various producing countries. At the time of preparing this Report replies to the Board's letter are to hand from Canada, Australia and New Zealand containing statements of the work that is being done in those Dominions.

A statistical survey of tobacco production and trade in tobacco products has been begun by the Board's staff and will be published in due course.

COPRA

Research in Malaya on Preparation of Copra for Export

In 1928 the Board approved a grant to the Government of the Federated Malay States in aid of research on the best methods of preparing high grade copra for export. It had long been known that compared with Ceylon copra the Malayan product was generally regarded as inferior in quality and realised a lower price on the market. The reason for this was, however, obscure.

The object for which the work was started was to ascertain wherein consisted the difference between Malayan copra and Ceylon copra. In 1931 the Assistant Chemist in charge of the work visited Ceylon for the purpose of comparing the conditions under which copra is produced in that Colony with those of Malaya.

As a result of the work the reasons for the lower quality of Malayan copra have been made clear and methods which would lead to improvement have been indicated. A Bulletin* has been issued describing the conditions under which coconuts are grown and copra is prepared in Ceylon and giving an account of the results of the work in Malaya.

TUNG OIL

Tung Oil Production and Research

Experimental trials with Tung trees, initiated during the past four years by the Imperial Institute Sub-Committee on Tung Oil, in collaboration with the Royal Botanic Gardens, Kew, and the Research Association of British Paint, Colour and Varnish Manufacturers, are still in progress and as a result information is being obtained in regard to those parts of the Empire which are most suitable for the cultivation of this crop. So far the most promising results have been obtained in Burma and Assam. In an increasing number of countries the trees have commenced to bear fruit. Samples of Tung nuts or oil from Assam, Bihar and Orissa, Ceylon, Nyasaland, Kenya, Natal and New Zealand have been examined and compared with the products from China and the United States, and the results indicate that it is possible to produce in the Empire Tung Oil of satisfactory quality. Although in many parts of the Empire the trees have started to bear, the trials have not yet been in progress sufficiently long to enable definite conclusions to be drawn as to yields of fruit or as to the economic possibilities.

The Paint Research Association has been carrying out investigations on various problems relating to the production of Tung oil. Besides examining samples from Empire sources the Association has conducted

* "Investigations on Coconuts and Coconut Products," by F. C. Cooke, A.R.C.S., B.Sc., A.M.I.Chem.E., Assistant Chemist for Copra Investigations. Department of Agriculture, Straits Settlements and Federated Malay States, General Series No. 8, 1932.

research on the preparation of the oil and, in co-operation with one of the large firms of oil-crushers, has investigated the respective merits of the expression and extraction processes. Existing methods for the evaluation of Tung oil have been developed and new ones devised.

Trials carried out at the Rowett Research Institute, Aberdeen, have shown that Tung seed meal is not suitable for feeding to animals.

Steps have been taken by the Imperial Institute to interest British firms in designing machinery suitable for the decortication of Tung fruits and nuts.

LAC

Lac Research and Marketing

The Board's Report for 1929-30 referred to a grant to the Government of Bihar and Orissa to meet half the cost for a period of five years of the employment of a Lac Marketing Expert in England to supplement lac research being carried out in India. Mr. A. J. Gibson, who holds this post, has made extensive contacts with the industries which use large quantities of resins, and with the research institutes concerned, and is investigating the optimum qualities required by consumers of lac to conform to modern factory technique. In addition, he has conducted a number of tests to elucidate problems of practical importance, raised in the course of discussion with actual users and research workers in the electrical, paint and varnish, plastics, gramophone record and other industries using shellac.

In India, the research work at the Lac Research Institute at Ranchi is concerned primarily with fundamental questions such as the life history of the lac insect, its insect enemies, the bionomics and the biochemical problems surrounding the insect itself and the host trees on which it feeds and the production and preliminary treatment of sticklac, seed-lac and shellac. In Europe, the International Electro-technical Commission of 1930 through its Advisory Committee on lac is preparing an international specification for buying lac for the electrical industries, the British National Committee of the commission being the British Standards Institution. Mr. Gibson is chairman of the above advisory committee, and also of the Lac Sub-Committee which was appointed in 1931 by the Advisory Committee

on Essential Oils and Resins of the Imperial Institute. Research activity in India and the United Kingdom thus covers all stages in the production and use of lac, from its harvesting as sticklac in India to the finished semi-raw material ready for use in the industries requiring it.

Throughout the period during which the Empire Marketing Board enquiry has been in progress, lac, like other tropical products, has suffered from the continual fall in the general price level. This, however, is not an unmixed evil, as lac products are thus available at prices which make it possible for them to compete on level terms with "synthetic" or substitute resins. Much work has still to be done in applied research on lac to improve present uses and processes and to find new uses. In order to maintain its position in the industries consuming natural and synthetic resins, lac must be freed from some of its present limitations, such as for instance low resistance to softening and deformation at temperatures met with in modern industrial practice, lack of resistance to water and water absorption, and the unstable properties of bleached lac. Experimental work so far done shows that lac mouldings can be made to resist temperatures up to 140° C., that de-waxed lac has a promising future in varnishes and polishes in combination with cellulose lacquers and that the problems of the oil-solubility of lac and of the esterification of lac are capable of solution. But quite apart from these advanced studies in the application of lac in modern industry it has already been found that good seedlac washed perfectly free from dye and impurities and converted without delay into shellac under controlled heat conditions, with no addition of adulterants such as rosin or orpiment, gives an article of commerce which, provided the price is competitive, meets with approval in the consuming industries. The Indian Lac Cess Committee is now fully aware of the difficulties surrounding the use of shellac in modern industry and is at present considering a scheme of research whereby three Indian chemists will be attached to applied research laboratories in the United Kingdom to study and elucidate the trade problems which will be put before them by the Lac Marketing Officer. In India, as a preliminary to compiling and publishing exact data on the physical, chemical and mechanical properties of shellac—a very large problem, a solution of which would be of great assistance to practical applied research in this country—the determination of the physico-chemical constants of sticklac, host by host, district by district and crop by crop has to be taken in hand.

In the new field of the plastics industry lac should have an assured position if, as some experts think, the future of the plastics trade tends towards design being built round the special properties of a plastic rather than the other way round. In any case, given a continuous and progressive policy of research, both in the fundamental and in the applied research problems surrounding the utilisation of lac, and, of course, stability of price on a competitive basis with the synthetic resins, there is no reason to doubt that lac will not only retain the position it has held so long in the markets of the world as a sound varnish and plastics material, but will also extend its scope and its uses and will be able to compete with its synthetic rivals on equal terms.

FLAX

Linen Industry Research Association, Lambeg, Northern Ireland

The chief aim of the Flax and Fibre Production Department, whose work the Empire Marketing Board is assisting, is the production of a high grade of fibre at a processing cost distinctly lower than any which has been touched hitherto.

Some time has been spent during the past year in an analysis of the cost of production of flax fibre under various existing systems and in a study of the factors, other than agricultural, which underlie the production of high quality fibre. The general conclusions were that the production of high quality and high yield of fibre are not necessarily dependent on any patentable process; that the chief factor is the care given to maintaining the straw in a parallel, unbroken and level condition at every stage, with, in addition, uniform retting; that the chief cost is the hand labour required to straighten and level the straw; and that the introduction of de-seeding and scutching machines, whilst it has decreased the labour employed in these two operations, has not increased the yield and quality of fibre, nor assisted mechanising the correct handling of flax straw. The next stage was to search for some basis on which to build up a system of flax working employing the minimum of hand labour, whilst retaining the desired parallelism and levelness of the straw. The de-seeding operation is the earliest stage at which the flax can be straightened up and levelled, and furthermore, flax straw is required in a thin layer for de-seeding, for drying after retting and for entry to a scutching machine. It was, therefore, conceived that if, at the

de-seeding, the flax could be securely fastened in a mat form it might be passed through all the later stages with a minimum of handling and without derangement. Many experiments have been devoted to the problem of fixing the de-seeded straw in mat form. A special chain stitch sewing machine was designed and built at the Institute with which several tons of flax straw have been successfully sewn into mat form. The advantage of sewing the flax into mats is most evident in the drying of the retted straw since the laborious and destructive practice of dividing the wet flax into handfuls for spreading and the subsequent operations of cocking and turning are entirely eliminated; it is only necessary to unroll the mat against a wire and re-roll when dry. The completion of a satisfactory breaker for flax in the mat will form the last main link in the process leaving only minor refinements to be worked out.

Excellent results were secured from the pedigree flax crop grown by His Majesty the King at Sandringham. Compared with flax from the U.S.S.R., this crop, processed under ordinary conditions, produced treble the yield per acre and a fibre worth over £20 per ton more. At present 80 per cent. of the raw material of the British Linen Industry is supplied from the U.S.S.R. A small exhibition of the products of the King's flax and the general processes of linen manufacture was staged at the Sandringham Show in July and by special request it was staged again at Sandringham in August for the private inspection of Their Majesties. The Empire Marketing Board has undertaken to publish, in its "Grey Book" series of Reports, an account of the Sandringham experiment and its bearing on flax growing and fibre production.

PINEAPPLES

Pineapple Canning Industry in Mauritius

Last year's Report referred to a grant to meet half the cost of importing 300,000 pineapple crowns from Hawaii into Mauritius in connection with attempts which are being made to establish a pineapple canning industry in the Colony.

The consignment was received in Mauritius in remarkably good condition considering the length of the voyage, and approximately 75 per cent. of the plants were viable. This has resulted in a comparatively large area being laid down in the Smooth Cayenne variety of pineapple.

FORESTRY AND FOREST PRODUCTS

Forest Products Research Laboratory, Princes Risborough

During 1932 applications for four major scale tests, three limited major scale tests, two preliminary tests and one special test were considered and accepted by the Empire Timbers Committee. Major scale tests of *Munyama* were undertaken on behalf of the Forest Department of Uganda, and it is anticipated that a report on the results will be issued in the near future. Major scale investigations of Ceylon *Gurjun* were begun in the latter part of the year at the request of the Forestry Department of Ceylon. It is hoped that an export trade in this timber may be developed as a result.

Crabwood from British Guiana was submitted to a preliminary investigation to determine whether it was suitable for the manufacture of airscrews. The timber proved exceptionally prone to splitting however, and for this reason, unsuitable. Further experiments have been recommended to investigate the possibility of seasoning it in such a way as to prevent splitting.

Reports have been issued on the preliminary investigations of *Greenheart*, *Purpleheart* and *Wallaba* from British Guiana, and of *Meranti Tembaga* and *Keruing* from Malaya. *Wallaba*, owing to a high gum content and a remarkable propensity to splitting, is unlikely to prove suitable for marketing in the form of sawn material in this country. Some interest in both the Malayan timbers has recently been apparent in trade circles. *Santa Maria* from British Honduras, *Musisi* and *Mujua* from Uganda, *Coachwood* from Australia and *Ofun* from Nigeria were undergoing preliminary investigations at the end of 1932.

Special tests of the acid-resisting properties of *Abura* from Nigeria have been suspended. This work was originally undertaken at the request of Lloyds Shipping Register to determine whether the timber was suitable for lining oil-carrying ships, but Messrs. Lloyds have since intimated that they are now satisfied that no wood is likely to prove suitable for this purpose. The investigations to discover a satisfactory method of softening East African *Pencil Cedar* have proceeded so satisfactorily that a process developed at the Laboratory is now undergoing commercial scale tests and it may be regarded as reasonably certain that the process in its present or slightly modified form will become a commercial proposition. A special investigation

of the mechanical properties of *Turpentine* has been undertaken at the request of the Falmouth Docks and Engineering Company to obtain strength statistics upon which specifications for marine constructional work will be based. A consignment of 58 sleepers of *Mora* was received from the Forest Department of Trinidad and these are being tested to determine whether they can be satisfactorily impregnated with creosote. Durability tests of *Western Hemlock* and *Western Red Cedar* are proceeding.

An investigation of the kiln seasoning properties of *Silver Beech* has been carried out for the New Zealand Government, and commercial tests of Indian-grown Honduras *Mahogany* were completed during the year and a report issued in July. The tests indicated that the *Indian timber* is very similar in quality to that grown in British Honduras and the growing of this species in India appears, therefore, to offer commercial possibilities.

With the consent of the Department of Scientific and Industrial Research, and with the support of the Governments concerned, the Empire Marketing Board has recently arranged for Major F. M. Oliphant, the Assistant Director of Research at the Laboratory, to visit Nigeria and the Gold Coast. This experiment in securing closer contact with Colonial Forestry Departments is expected to yield valuable results and useful guidance as to future policy.

MECHANICAL TRANSPORT

The Oversea Mechanical Transport Directing Committee has been chiefly occupied during the past year in testing and improving the first 15-ton unit. It will be remembered that this unit consists of an 8-wheeled tractor and two 8-wheeled trailers, designed to provide transport over cheaply constructed roads at an economic cost. On the completion of 5,000 miles running in England certain modifications were carried out in order to strengthen the driving shafts and increase the wheel articulation of the tractor and to decrease the tare weight of the trailers. After further tests to ensure that these modifications were satisfactory, the unit was shipped to the Gold Coast in February, 1933, to undergo further trials there. The vehicles are now running between Kumasi and Tamale—a distance of 240 miles. Detailed records are being kept to enable the running costs to be ascertained.

A second 15-ton unit has recently commenced its tests. The Committee has embodied in the vehicles the improvements which it found possible as a result of experiments conducted with the first unit. The second tractor is fitted with a heavy oil engine and its design has been simplified. It is proposed to test this unit also in England and then to send it abroad for further trials on some commercial transport route.

It is hoped, if sufficient funds are available, to apply the lessons learnt as a result of the construction and tests of these units to the design of a unit built on similar lines to handle a useful load of 30 tons. The Committee believes that with such a unit it should be possible to handle freight at a total operating cost of about $3\frac{1}{2}$ d. per ton mile, even in areas in which no return loads are available.

The tests carried out in the Sudan with a 30-cwt. lorry fitted with special tyres and a "Still" tube radiator have yielded data that will be useful to those concerned with transport over soft and sandy ground in areas with high sun temperatures.

Trials of various motor vehicles likely to be useful for work overseas have been continued during the year. Confidential reports on these trials are circulated for the information of officers who may be interested and any shortcomings revealed by the tests are discussed with the manufacturers.

The publication of the Quarterly Bulletin has been continued during the year.

FISHERIES

Fishery Research in Newfoundland

The objects of the Newfoundland Fishery Research Commission are the investigation of the life-histories, fluctuations and movements of the principal fishes of Newfoundland, and the improvement of some of the existing methods of processing and marketing the fish products and by-products. As mentioned in last year's Report a Biological Laboratory was established in 1931 in the outport of Bay Bulls about 18 miles south of St. John's.

On the biological side the aim during the first year's operations was to make a general and rapid survey of the fauna and its relationships in the waters of the area accessible to the fishing activities of

Newfoundland. Data were collected during a cruise of the research vessel "Cape Agulhas," and the shore fishery (caplin, salmon, cod, etc.) was investigated throughout the season in the neighbourhood of the Laboratory; in addition tours were made on the various coasts by fishery officers. The data is being dealt with in the Laboratory. First studies of the salmon and caplin have been completed and published.*

Investigations have been initiated into the properties of Newfoundland Cod Liver Oil with special reference to the correlation of colour and vitamin content. A study has been made of the scientific principles involved in the processing of cod-fish by salting and drying, and a series of bacteriological examinations of fish products has been carried out with a view to aiding inspectors who have to certify or reject products. In connection with by-products, fish meals prepared from many sources are being analysed to determine market grade and mixing quality. Soaps have been prepared from stearin residues and fish-glue from the skins of salmon.

The First Annual Report of the Fishery Research Commission† gives a full account of the programme of work.

MISCELLANEOUS

Comparative Study of Methods of Soil Analysis

The Report on the comparative study of methods of soil analysis, carried out with a grant from the Board at the University College of North Wales, was completed in December, 1932. It has been issued by the Imperial Bureau of Soil Science in its series of Technical Communications.‡

* "Biology of the Salmon (*Salmo salar* L.) taken in Newfoundland waters in 1931," by Sheila Taylor Lindsay and Harold Thompson. Reports of the Newfoundland Fishery Research Commission, Vol. I, No. 2, 1932. "Observations upon the Economic Biology of the Caplin (*Mallotus villosus*, O. F. Müller)," by G. F. Sleggs. *Ibid.*, Vol. I, No. 3, 1932.

† "Annual Report, year 1931." *Ibid.*, Vol. I, No. 4, 1932.

‡ "The Dispersion of Soils in Mechanical Analysis." Technical Communication No. 26 of the Imperial Bureau of Soil Science. H.M. Stationery Office (price 2s. 0d.).

TRAVELLERS

It has not been possible, on account of the limited resources available to the Board during the past year, to give effect, to the extent desirable, to the policy of assisting the interchange of scientific personnel, of producers' representatives and of marketing experts. A limited amount of travelling by scientific experts has, however, been possible. Mention has already been made of the visit to Australia and New Zealand by Mr. William Davies, the " Empire Grassland Officer " from Aberystwyth, and of the visit to Nigeria and the Gold Coast by Major F. M. Oliphant, of the Forest Products Research Laboratory, Princes Risborough, with a view to establishing closer contact with Colonial Forest Departments. Dr. I. B. Pole-Evans, Chief of the Division of Plant Industry in the Union of South Africa, visited Swaziland in May, 1932, for the purpose of studying pasture grasses. At the invitation of the Dominion Agrostologist, Dr. J. W. Gregor, of the Scottish Society for Research in Plant Breeding, has visited experimental stations in Canada to study Canadian pasture conditions and to arrange for the exchange of pasture plants. He also visited Eastern America to collect material for investigations dealing with the composition of geographical races. Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, returned in May, 1932, from a four months visit to the West Indies, Bermuda, British Guiana and British Honduras. The exchange between Mr. R. V. Harris of the East Malling Fruit Research Station and Dr. G. H. Berkeley of Ontario, referred to on p. 65 of this Report, will take place in June of this year.

II. MARKETING, ECONOMIC INVESTIGATION AND MARKET INTELLIGENCE

MARKETING OF HOME AGRICULTURAL PRODUCE

ENGLAND AND WALES

Grants amounting to £66,000, which included a special sum of £17,500 provided from the Exchequer for foreground publicity and passed through the Empire Marketing Fund as a matter of administrative convenience, were made available to the Ministry of Agriculture and Fisheries for marketing services in 1932-33. These grants were devoted to the services described below. For the first half of the current financial year (1st April to 30th September, 1933) grants of £32,500 have been approved which include £8,250 for foreground publicity purposes.

Investigations and Reports.—In developing its programme the Ministry first undertakes a thorough investigation for each commodity with a view to formulating suggestions for improvement on the lines of standardisation and organisation. The results of these investigations are published in the Economic Series of Reports—popularly known as the “Orange Books.” The number of Reports issued is now 34, and over 186,000 copies have been sold. Three Reports were issued during the year and further Reports—on the marketing of vegetables, jam, calves and veal, and hides and skins, on the fruit canning and bottling industries, and on the organisation of milk marketing abroad—are in preparation.

Demonstrations.—Demonstrations in improved methods of marketing were staged at sixteen of the principal agricultural shows during the 1932 season. These dealt with standard methods of preparing commodities for market and types of organisation for the marketing of wool and potatoes. The range of subjects included those commodities to which the National Mark has already been applied, and those for which it is proposed to introduce National Mark schemes in the immediate future. Demonstrations were also given at certain other shows and exhibitions such as the Imperial Fruit Show, the London Dairy Show, and the Smithfield Club Fat Stock Show.

Standardisation.—National Mark schemes are now in operation for beef (in London, Birmingham, Leeds, Bradford and Halifax), eggs, dressed poultry, apples, pears, plums, strawberries, cherries, tomatoes, cucumbers, canned fruit and vegetables, bottled fruit and vegetables, cider, wheat flour, malt flour, malt extract, honey, cauliflower and broccoli, and cabbage lettuce. The last two schemes were introduced early in 1933. Schemes for applying the National Mark to gooseberries, blackcurrants, redcurrants, raspberries, loganberries, grapes, asparagus, bunched carrots, celery, brussels sprouts, jam, Cheshire cheese, and mutton and lamb are under consideration.

In all the schemes, quality-control has been exercised by inspections at factories or packing premises where products intended for processing or packing under the National Mark were being dealt with. In addition, the packed product has been inspected at the wholesale markets and other centres of distribution, including wholesalers' and retailers' premises. During 1932, over 3,000 visits were paid to packing premises and approximately 2,250 inspections of packed produce on distributors' premises were made.

In the case of processed commodities, e.g. canned fruits and vegetables, cider, flour and honey, samples were taken at the point of production, and also in shops. These samples were examined at the Campden Research Station or at the Government Laboratory. Thus, nearly 2,000 samples of canned fruits and vegetables and approximately 400 samples of flour were examined in 1932.

Reports on samples were furnished to the authorised packers and any breaches of the statutory requirements as regards quality, etc., reported to the appropriate Trade Committee.

Satisfactory results were recorded during the past year, the schemes that were particularly successful being those for eggs and canned fruit and vegetables. The number of eggs handled by the National Mark egg packing stations during 1932 was 384 millions, an increase of 73 millions on the number handled in 1931. The output of National Mark eggs has nearly doubled in the past two years. Increased quantities of National Mark canned fruit and vegetables were also put on the market.

Well over a quarter of a million sides of beef were graded and marked during the year 1932 for the trade in the three areas—London, Birmingham and Leeds, Bradford and Halifax—in which grading

facilities have been provided. By the end of that year, a total of over 825,000 sides had been graded and marked. Increased use is being made by farmers of the experimental scheme, introduced in March, 1930, for the direct consignment of cattle for sale on a dead-weight and carcase-grade (National Mark) basis.

Publicity.—The main items of publicity undertaken for National Mark commodities were :—

National Mark Shopping Weeks in nine provincial towns, at which displays of National Mark products were staged. Other local activities included press advertising, shop-window display competitions, film displays, and essay-writing competitions for school children.

Displays of National Mark products in other towns, including those in which the Board had " Empire Shops."

Advertising of National Mark beef in the Birmingham, Leeds, Bradford and Halifax newspapers, and of other products in trade journals and certain newspapers and periodicals with a national circulation.

The Empire Marketing Board's advertising frames were leased on two occasions for the display of National Mark posters.

Display material issued to traders stocking National Mark products.

Booklets and leaflets issued to the general public.

Lectures and film displays to producers, distributors and the general public. For three months in the summer of 1932, two travelling film vans visited some of the larger centres of population and in 1933 a portable sound projector has been tried with good effect in connection with lectures to producers.

Flour and bread-making competitions at the Bakers' and Confectioners' Exhibition.

Shop Window Display Competitions in Birmingham, Leeds and London.

Cookery demonstrations in association with gas and electricity undertakings.

In addition, circular letters were sent to traders' associations and others, and material was prepared for articles, press paragraphs, and for broadcasting.

Organisation.—A Report on the Organisation of Wool Marketing was issued as an "Orange Book" in June, 1932.

Reorganisation Commissions were appointed by the Minister of Agriculture and Fisheries under the Agricultural Marketing Act, 1931, to prepare schemes for regulating the marketing of pigs and pig products, milk, and fat stock, respectively. The Reports of the first two Commissions were published as "Orange Books." The Fat Stock Commission is still pursuing its enquiries. Marketing schemes for pigs, bacon and milk, and also for potatoes, have been submitted to the Minister and are now under consideration.

Miscellaneous.—Sub-grants have been made by the Ministry to certain University Departments of Agriculture, Agricultural Colleges, and to co-operative and other commercial organisations, to enable them to conduct various marketing investigations or experiments, or to serve as demonstration centres.

SCOTLAND

Grants amounting to £6,510, which included a special sum of £2,060 provided from the Exchequer for foreground publicity and passed through the Empire Marketing Fund as a matter of administrative convenience, were made available to the Department of Agriculture for Scotland for marketing services in 1932-33. These grants were devoted to services in respect of the marketing of beef, eggs, tomatoes and canned fruit, Scottish National Mark Labels, exhibits of Scottish National Mark and other Scottish produce, economic enquiries and other activities. For the first half of the current financial year (1st April to 30th September, 1933) a grant of £4,380 has been approved. This includes £1,030 for foreground publicity purposes.

National Mark Schemes.—No new Scottish National Mark Schemes were inaugurated by the Department. The commodities to which the Mark has been applied are:—eggs, tomatoes, ware potatoes, malt products, canned fruit and beef.

Eggs.—The number of registered packers of eggs is now 46. Since the inception of the scheme 128,000 National Mark Labels have been issued, representing approximately a quantity of 3½ million dozens of graded and tested eggs produced in Scotland.

Tomatoes.—There are now 68 growers approved as registered packers of Scottish National Mark Tomatoes and to date 132,500 labels, representing nearly 700 tons of tomatoes, have been issued to them.

Potatoes.—Thirty-four potato growers and merchants are authorised under the Scottish National Mark scheme for ware potatoes and 42,500 labels have been issued in respect of this scheme.

Malt.—The number of manufacturing firms authorised as packers of malt extracts and malt flours manufactured wholly from Scottish home-grown barley is the same as in 1931, viz., twelve.

Beef.—The Report of the Second Inter-Departmental (Kirkley) Committee* appointed to “review the progress made by the English and Scottish schemes for grading and marking beef,” was issued in March, 1932. The Committee recommended that pending the formation of an organisation of beef feeders which under the Agricultural Marketing Act, 1931, might enforce grading and marking, the Departments of Agriculture should be empowered to carry on the scheme in prescribed areas and recover the cost of grading and marking from the owner of the beef.

A small Committee was thereupon appointed and made proposals for carrying the above-mentioned recommendation into effect. In October, however, a Reorganisation Commission was appointed to prepare a scheme for regulating the marketing of fat stock in Scotland and meantime the Department arranged for the continuance of the voluntary scheme to the 31st March, 1933.

The number of butchers and dealers registered for the purpose of the scheme in 1932 was 208. During the year 58,737 sides of beef were graded and marked representing approximately 8,250 tons of beef. The facilities provided for the grading and marking in London of pieces of Scottish-killed beef consigned from other areas in Scotland were continued in 1932, and under this arrangement 382 pieces of beef were presented for grading.

Canned Fruit.—The number of firms registered under this scheme is now six. Five of these firms have been authorised to incorporate the Scottish National Mark design in their private brand labels. Accordingly the number of official labels issued by the Department

* Cmd. 4047, 1932.

to registered canners is small, viz., 321,500, of which only 75,000 were issued in 1932. As anticipated there was a great increase in the output of Scottish National Mark canned fruit in 1932 as compared with 1931. It is estimated that not less than 2,300,000 cans of Scottish National Mark canned fruit were placed on the market in 1932.

Exhibitions.—In conjunction with the Fishery Board for Scotland the Department organised displays of representative Scottish agricultural and fishery produce at exhibitions in England and Scotland in which the Empire Marketing Board participated, at Empire Marketing Board shops, and at a few of the more important agricultural shows in Scotland. Displays were presented at the following exhibitions :—

Nation's Foods Exhibition, London, May–June, 1932.

International Grocers' Exhibition, London, September, 1932.

British Industries Fair, London, February, 1933.

Scottish Grocers' & Allied Trades Exhibition, Glasgow, March, 1933.

Reports received by the Department indicate that participation in these exhibitions continued to stimulate the demand for Scottish produce and assist the home producer.

National Mark Publicity.—The funds made available for foreground publicity enabled the Department to continue their publicity service for Scottish National Mark produce. The Board's poster frames throughout Scotland were leased and posters advertising Scottish National Mark eggs and tomatoes exhibited thereon. By means of adhesive transparencies the Department continued to advertise these goods on omnibuses in the south-west of Scotland.

Improvement of Pork and Bacon Production.—In the first series of feeding experiments with pigs, which covered the period January to July, 1932, a comparison was made between the results of using (i) a standard ration recommended by the Rowett Research Institute, (ii) the same ration modified to suit local conditions and supplies, and (iii) foodstuffs ordinarily used locally. These experiments were of a preliminary nature and a second series is now proceeding. It is hoped, as a result of the experiments, to draw up a list of alternative standard rations which can be recommended for use by pig feeders in varying conditions of the feeding stuffs market.

Economic Investigations.—Reports upon the marketing of live-stock and potatoes in Scotland have been completed and are in the press.

NORTHERN IRELAND

During the past year an enquiry into the marketing of dairy produce was started. The existing data available in the Northern Ireland Ministry of Agriculture have been collected and analysed and subsequent investigations carried out in the principal creamery and dairy districts. The field work has now been completed and a report is being prepared.

Enquiries have been made into the possibility of introducing a scheme for the grading of Northern Ireland store cattle, with special reference to the export trade. The Department of Agriculture for Scotland has assisted in this enquiry.

One of the suggestions made in the Report on the Marketing of Northern Ireland Agricultural Produce, issued in May, 1932, related to the encouragement of the sale of cattle by weight instead of by head, as is the general practice in Northern Ireland. With the object of interesting farmers in the sale of cattle by weight, arrangements were made to hold cattle weight and value judging competitions at some of the more important agricultural shows. These competitions received a large measure of support.

An Agricultural Marketing Bill, on lines broadly similar to those of the English Act, is being introduced into the Northern Ireland Parliament, and the Ministry of Agriculture proposes to proceed with Marketing Schemes under the Act, starting with pigs and bacon.

A grant of £400 has been approved for continuing this work during the first half of the current financial year.

The enquiry into the economic position of small farms was continued throughout the year. Accounts are at present being kept on 40 farms ranging in size from 12 statute acres to 155 statute acres. Seventeen of these farms are now keeping accounts for the third successive year whilst five are keeping them for the second successive year. The average size of the farms which have kept accounts has been around 60 to 65 statute acres.

The accounts which are kept in detail by a member of the farmer's household have been analysed and summarised up to the year

ending 30th September, 1932, and comparative data are now available for a small number of farms over the period during which the scheme has been in force. It is hoped to issue an interim report in the near future setting out the results of the enquiry to date.

MARKETING BRANCH

Market Promotion

The Board's relations with trades and traders and its system of direct market promotion have both been still further developed during the year under the planning and supervision of the Marketing Committee. Owing, however, to the general reduction in the funds at the Board's disposal, these developments have been along the lines of existing activities rather than in new or experimental fields.

The value of the goodwill of the distributive trades to the successful prosecution of the Board's activities has long been recognised. Every opportunity has accordingly been taken, through the Board's Advisory Trade Committees, by visits to trade organisations and by contact and conversation both with officials of organisations and with individual traders, to cultivate that goodwill. The creation and maintenance of close relations with the distributive trades, and the accumulation of expert knowledge of trade conditions are largely intangible processes; they depend on day to day contacts and consultations. The results, whilst of inestimable value to the Board's work as a whole, cannot be assessed with precision.

Bulk Purchasers

The results which have followed the campaign of direct approach to bulk purchasers of commodities can be more definitely recorded. Since the inception of this campaign the Board's officers have visited—

- (a) all the major Local Authorities in Great Britain and Northern Ireland, with the result that tender forms covering supplies to some 1,500 institutions have been submitted to the Board for suggested amendment in favour of Empire purchases;
- (b) most of the principal Railway and Shipping Companies;
- (c) over 200 large hotels;
- (d) 150 canteens;
- (e) some 300 Public Schools, and
- (f) 150 voluntary hospitals.

In practically every case the approaches have met with a cordial welcome ; indeed, in many cases the visit of the Board's officer has been made as a result of a spontaneous request for advice or assistance. The Board's records show that numerous changes from foreign to Empire commodities, involving large quantities and a wide range of products, are resulting directly from this campaign.

The work in this field has not been entirely confined to foodstuffs. For example, every opportunity has been taken to advocate a wider use of Empire timbers in building and constructional work ; the claims of ropes and cordage made from Empire sisal for marine and other uses have been stressed ; English-made glass has been pressed in substitution for foreign ; and hospital supplies have been examined with a view to securing, wherever possible, the use of a home manufactured article. In these, and in many other directions, the Board has turned to full advantage the many contacts which have been established.

The Work of the Trade Advisory Committees

The success of much of the work achieved under the direction of the Marketing Committee can be traced directly to the advice and assistance which have been rendered by the various Trade Advisory Committees. The members of these Committees, representative as they are of the importing, manufacturing, wholesaling and retailing branches of the food trades, have freely placed at the Board's disposal their expert knowledge and wide experience. They perform an invaluable service, not only in regard to the many problems of production and distribution of commodities on which their advice is sought, but also in maintaining and cementing the goodwill of the distributive food trades which is so essential to the success of the Board's activities.

Commodity Enquiries

The Marketing Branch has dealt with a sustained volume of practical enquiries about the marketing of Empire products. These enquiries have covered a wide range of commodities, extending in some instances far beyond the range of goods normally stocked by food traders. Many business men have called personally at the Board's offices, seeking information about the Empire sources of supply of particular commodities or about possible avenues for the marketing of Empire products in which they were interested. In dealing with such enquiries the Board's officers have maintained constant touch with

the London representatives of the Empire countries concerned. The combination thus achieved between a wide range of experience in the Board's offices and the more detailed and special information at the disposal of the Trade Commissioners of oversea Governments has, the Board is satisfied, secured a degree of efficiency in market promotion which neither type of agency could have secured in isolation.

TRADE MEETINGS

Members of the Marketing Branch addressed meetings of Chambers of Commerce and Trade, business men, distributive traders and producers at the undermentioned places during the last twelve months :—

Acton	Ealing	Port Talbot
Aldershot	East Molesey	Rochester
Barnes	Edinburgh	St. Albans
Birmingham	Edmonton	Scarborough
Brighton	Hammersmith	Sheffield
Bristol	Hull	Southend
Callander	Ilford	Sydenham
Cardiff	Kennington	Twickenham
Chatham	Kingston-on-	Watford
Chingford	Thames	West Wickham
Chiswick	Leatherhead	Wing (Bucks)
Colwyn Bay	Luton	Wood Green
Croydon	Newtown	
Dover	Newport	

MARKET INTELLIGENCE SERVICES

The various market intelligence services established by the Board, dealing with fresh fruits and vegetables, canned and dried fruits, dairy produce and pig products, have been maintained during the year, their scope has been enlarged, and other improvements have been effected. The Board's limited resources have precluded the establishment of new intelligence services, with the exception of monthly notes and statistics on wool, the first of which were issued in April, 1933.

Fresh Fruit.—The Weekly Fruit Intelligence Notes have now entered upon the seventh year of their publication. Circulation has been well maintained in spite of an increase in the subscription rate to 20s. per annum. At the end of March about 2,500 copies were being distributed each week, including a free list of 1,400, mainly composed of growers and organisations of growers in the Empire.

In order to make the Notes more nearly self-supporting, the subscription rate has been further increased as from the 1st April, 1933, to £2 per annum to traders and £1 to producers and producers' organisations in the Empire, the free list being greatly reduced. It is too soon to say what reduction in circulation will result from these increases in subscription rates, but it is already evident that there will be a material increase in the subscription revenue.

Dairy Produce and Pig Products.—The Weekly Dairy Produce Notes completed their fourth year at the end of May. During the past year the range of information given in these Notes has been extended, more attention being given to the frequent changes in the European market situation brought about by tariffs and quotas. Notwithstanding an increase in the subscription rate in June, 1932, circulation has been practically maintained at about 2,500, the greater part of these, however, going to Empire producers and producers' organisations, to whom no charge has so far been made.

From the beginning of the fourth volume of the Notes it is proposed to increase the subscription rate to £2 per annum to traders, and to charge Empire producers, dairies and associations £1 per annum.

Canned and Dried Fruit.—The second year of issue of the monthly Canned and Dried Fruit Notes has now been completed. During the past year the particulars of arrivals of canned fruits given in the weekly supplement to these "Notes" have been extended to show the ultimate port of destination of canned fruits intended for trans-shipment. The subscription rate for the Notes has been raised from 10s. to 20s. per annum, as from the 1st May. At the end of April the circulation list totalled about 600; Empire growers and canners, who have hitherto received free copies, constituted about 80 per cent. of this total.

Wool.—A monthly Wool Intelligence Service was begun in April, 1933, and the first issue secured a circulation of nearly 1,000 copies. These Notes, which are at present issued in stencilled form and free

of charge, include the latest available particulars of wool production, exports, imports and stocks for the more important Empire and foreign countries. Information is also given about prices, utilization and activity in the textile trade so far as such information is available and it is hoped that the service will become of increasing value as international wool statistics improve.

Annual Supplements to Intelligence Notes

Annual supplements* were issued in 1932 giving detailed figures of imports of fruit, dairy produce and canned and dried fruits into the United Kingdom, as well as other information about the year's supplies. Similar supplements are being issued this year, dealing with supplies in 1932.

Reports on Foreign Crop Conditions

At the Board's request the Foreign Office obtained from the Soviet Government a diplomatic visa enabling Mr. Cairns, the Board's wheat intelligence officer, to visit Russia in the spring and summer of 1932. His confidential reports on his four months' trip through European and Asiatic Russia have, for the first time, enabled Empire Governments to obtain a first-hand picture of agricultural conditions in Russia. Numerous letters have been received expressing high appreciation of their value. In order to complete his studies of Russian agriculture, it is hoped that Mr. Cairns may be able to pay another visit to Russia this year.

In the spring of 1932 the Board engaged a part-time correspondent in the Argentine. In addition to supplying regular information on dairy produce and fruit shipments, he has supplied monthly reports on grain and other agricultural commodities to Government Departments and producers' organisations in Canada, Australia, New Zealand, India and Southern Rhodesia. He has also sent, upon request, cabled information at their expense to Government Departments and producers' organisations in Canada and Australia. The demands upon the Board's correspondent for special studies of the conditions and production of competitive products, particularly fruit and dairy produce, are more than he is able to meet. If funds had permitted, the Board would have contemplated appointing a whole-time correspondent for this service.

* Fruit Supplies in 1931 (E.M.B. 49). Dairy Produce Supplies in 1931 (E.M.B. 52). Canned and Dried Fruit Supplies in 1931 (E.M.B. 55).

Broadcasting of Market Intelligence

Following the inauguration of the Empire Broadcasting Service, the Board was invited by the British Broadcasting Corporation to draw up plans for the regular inclusion of market news in the programmes. The dissemination of market information throughout the Empire through the medium of the Empire Broadcasting Service is clearly capable of far-reaching development, but in its initial stages it must be largely experimental. Pending reports from the Empire overseas on the quality of the reception and the needs of listeners, the intelligence service, which was begun in May, 1933, is being restricted to two-minute talks, twice weekly, on fruit and dairy, pig and poultry produce. In preparing the notes for the service the Board is working in collaboration with Trade Commissioners and London representatives of oversea producers.

In addition to the preparation of market information for weekly transmission, the Board is co-operating with the British Broadcasting Corporation in arranging talks upon individual commodities for inclusion in the programmes from time to time. The first of these is being given by Mr. W. P. Devereux, European representative of the Australian Wool Growers' Council, who is talking on wool to listeners in Australia, New Zealand and South Africa towards the end of May, 1933.

WORLD SURVEYS OF PRODUCTION AND TRADE

Further world surveys of production and trade concerning commodities of major importance to Empire producers have been issued, a *Wool Survey* in July, 1932, Vol. II of the *Oilseeds and Vegetable Oils Survey*, dealing with Coconut Palm Products, in December, 1932, and a *Barley Survey*, for which Professor H. C. Grant, of the University of Manitoba was responsible, in March, 1933. Surveys of Cattle and Beef, Mutton and Lamb and Vol. III of the Oilseeds series, dealing with Groundnuts, are in advanced stages of preparation, and work on a survey of Tobacco has been started.

The preparation of the Wool Survey revealed a number of weaknesses in the statistical information available about wool production and utilization, and, on the recommendation of the Board's Wool Statistics Advisory Committee, the co-operation of the International

Institute of Agriculture and of the International Wool Textile Organisation has been sought with a view to securing improvement and co-ordination in the world's wool statistics.

A second report on wool, dealing with imports and consumption, is also in preparation. By arrangement with the port authorities, figures of stocks of wool in warehouses are now being collected and issued six times a year.

WASTAGE IN IMPORTED FRUIT

During 1932 the Board co-operated with the Food Investigation Board of the Department of Scientific and Industrial Research in the examination of a series of experimental consignments of apples and pears arranged by the New Zealand Department of Scientific and Industrial Research. The experiments were designed to test the effect of locality, soil type, and maturity upon the quality of the fruit shipped overseas, to estimate the influence of wastage of different types of wrapping and packing and of different methods of handling. The work is being continued on a reduced scale this season.

At the request of the South African Co-operative Citrus Exchange the Board undertook during the past season a series of tests on the juice content, sugar to acid ratio, weight and skin thickness of South African oranges and of oranges from competing sources. Samples of South African, Brazilian and Californian oranges were examined in July, August and October, and, as it was felt that further information with regard to the grapefruit, lemons, and oranges on the market during the winter months would be useful to the South African growers, further tests were carried out in February on Palestine, Egyptian, Californian and Spanish oranges, Palestine and Jamaican grapefruit and Italian lemons. A series of reports has been forwarded to the Citrus Exchange.

During the past season an inquiry has been made into the percentage of waste in British Columbian apples arriving in this country. Cards for retailers to return to the Board, with particulars of the condition of the fruit upon opening, were inserted in the boxes at the packing sheds in British Columbia. A few cards are still being received, but the proportion returned has been disappointing.

EXPERIMENTAL CONSIGNMENTS AND MARKET ENQUIRIES

The co-operation of the Board has been extensively sought by oversea Governments for investigation into the technical and marketing problems involved in connection with the export of fruits and fruit products not previously exported.

The shipments reported upon include pineapples from Nigeria, oranges and lemons from Tanganyika, mangosteens from Burma and tomatoes from Grenada.

In addition, a large number of enquiries have been made, at the request of oversea Governments and producers' organisations, into the marketing of various products in the United Kingdom. Information has been collected dealing with the extent and nature of competitive supplies and with market requirements in regard to quality, grading and packing. Reports on the following commodities have been prepared: Figs and fig paste, crystallized fruits, tomatoes, oranges, banana chips and banana flour, pumpkins, dom nuts, orange pulp, celery, asparagus, limes, grapefruit, lemons in brine, potatoes, pomegranates, sultanas and mangoes.

RETAIL SURVEYS

At the request of the South African Citrus Fruit Exchange a survey was carried out during the summer of the retail market for South African Citrus Fruit. Information was collected regarding local variations in the demand for South African oranges, naartjes and grapefruit and of competitive fruit. A short preliminary report has already been made to the South African Citrus Fruit Exchange and the full report will be published at an early date.

During the latter half of the year a survey of the retail demand for meat has been in progress. Investigations have been made in six of the most populous areas of the country, and, although the results obtained show great variation as between different areas and make it clear that no single area or group of areas can be regarded as typical of the rest of the country, yet there is no doubt that for the districts covered the information collected will be of considerable value. The inquiry has covered beef, mutton, lamb, pork and veal.

A Report of the canned vegetable survey was published in July 1932, and a report on the retail marketing of South African deciduous fruit has recently been issued.

STATISTICAL PAMPHLETS

The series of statistical pamphlets dealing with the trade and production of the principal agricultural commodities has been continued by the issue of booklets on Grain Crops (wheat, wheat flour, barley, oats, maize, rice, and rye); Meat (beef, cattle, mutton and lamb, sheep, bacon and hams, pork, pigs, and canned meat); Oil-seeds and Vegetable Oils (copra, groundnuts, cottonseed, linseed, olive oil, soya beans, sesame seed, rapeseed, palm kernels, palm oil, and whale oil); and Plantation Crops (sugar, tea, coffee, cocoa, rubber, tobacco and spices). The pamphlets have had a very wide circulation and the information they convey has been appreciated and used in all parts of the Empire. Further booklets are in course of preparation.

III. PUBLICITY

For the year 1932-33 provision was made in the Board's printed estimate for an expenditure of £62,820 on publicity.

NEWSPAPER ADVERTISING

Financial limitations again precluded the undertaking of any press advertising on a national scale.

Advertisements relating to Empire Shopping Weeks in which the Board co-operated, and to the Board's own Empire Shops, were inserted in local newspapers. In addition, a few advertisements were inserted in trade and other special journals.

POSTERS

(a) *Displays on the Board's own Poster Frames.*—During the year twelve sets of posters were displayed by the Board on its 1,700 special poster frames which are erected in some 475 of the chief cities and towns in the United Kingdom. In addition, two sets of posters dealing with the "National Mark" were displayed on the Board's frames in England and Wales, by and at the charge of the Ministry of Agriculture and Fisheries, and one set in Scotland by the Department of Agriculture for Scotland.

The following subjects were dealt with in the Board's own posters :

- (1) Home Products (Photographic).
- (2) Colonial Trade.
- (3) The Ottawa Conference.
- (4) Empire Trade (Letterpress).
- (5) Home Products.
- (6) Empire Trade (Letterpress).
- (7) "Service of Empire."
- (8) The Union of South Africa.
- (9) Empire Trade (Letterpress).
- (10) British Industries Fair (Letterpress: in co-operation with the Department of Overseas Trade).
- (11) Empire Tea.
- (12) Buy Empire by Telephone (in co-operation with the General Post Office).

(b) *Poster Reproductions for Schools.*—Over 27,000 schools in the United Kingdom are now included in the Board's standing list to receive regularly copies of poster reproductions and leaflets as issued. Reproductions of six of the Board's posters, including two map posters, were issued during the year. In so far as stocks allowed, copies have also been sent on request to schools in the Empire overseas.

(c) *Shop Display Material.*—Two new items of display material only were issued, but the stocks of material were maintained by reprints of a number of earlier designs.

(d) *"Contract" Posters and Labels.*—The "contract" poster and label scheme, which is operated in conjunction with firms receiving orders from oversea parts of the Empire, has been continued, but on a necessarily reduced scale.

LEAFLETS, ETC.

A catalogue with small colour reproductions of the principal items of the Board's shop display bills, strips and cards was prepared for issue to applicants for large quantities of this material. The introduction of this catalogue has rendered unnecessary the despatch of copies of the actual display bills, etc., as samples, and a considerable saving has thus been effected in material and postage.

New leaflets, etc., were issued on the subject of:—

Empire Timbers.

Winter Fruits from South Africa.

British Grown Roses.

British Grown Bulbs (Retail Section).

British Grown Bulbs (Wholesale Section).

In addition nine of the earlier leaflets were reprinted.

Leaflets on the following subjects were issued to accompany school reproductions of posters:—

"New Zealand."

"The Great and Rich Island of Borneo."

"Flax Fields and Linen Mills of Northern Ireland."

"The Union of South Africa."

"British Malaya."

"A Scottish Oat Harvest."

To date, approximately ten million leaflets and pamphlets have been distributed by the Board.

EMPIRE TIMBERS

"The Handbook of Empire Timbers," issued by the Board during the year, besides dealing *in extenso* with 60 Empire woods in general commercial supply in the United Kingdom, brings to the notice of the public the facilities now available to obtain information concerning Empire timbers. These include:—

- (a) a register, maintained by the Board, of notable instances in which Empire timbers have been used in the United Kingdom;
- (b) specimens of some 60 Empire timbers presented by the Board to the Architectural Association in London and to seven of the principal schools of architecture in various parts of the British Isles;
- (c) the addresses of various official bodies from which technical information regarding Empire timbers can be obtained.

The book itself provides an authoritative work of reference, in particular for architects, engineers, and furniture designers.

The set of samples of Empire woods presented to the Architectural Association is now on permanent exhibition at the Building Centre in New Bond Street.

The "Buy British" Sub-Committee of the Forum Club, in co-operation with the Board, arranged a successful exhibition of Empire woods at the Club's premises in Grosvenor Place, which was opened by the Rt. Hon. The Earl of Athlone during the first week of February, 1933.

LECTURES

Lectures were delivered by the Board's speakers, mainly to women's organisations and Trade Associations, to audiences aggregating over 58,000. Of these lectures 734 dealt with Empire marketing and the products of different Empire countries. In addition 123 lectures on the subject of the National Mark were arranged on behalf of, and at the charge of, the Ministry of Agriculture and Fisheries.

BROADCASTING

By arrangement with the British Broadcasting Corporation a series of "Housewives' News" was broadcast weekly on Tuesdays from May to August, 1932. This series dealt with the various Empire products in season and included a guide to ruling market prices.

The opening of the new short wave Empire Broadcasting Station at Daventry in January last has presented important new opportunities for the dissemination throughout the Dominions and Colonies of information concerning Empire trade.

The British Broadcasting Corporation have welcomed suggestions from the Board of suitable material for transmission through this station.

EXHIBITIONS, EMPIRE SHOPS AND EMPIRE SHOPPING WEEKS

(a) The Board participated in the following Exhibitions :—

1932—

21st May—4th June, The Nation's Foods Exhibition.
3rd Sept.—9th Sept., The Bakers' and Confectioners' Exhibition.
17th Sept.—23rd Sept., The International Grocers' Exhibition.
21st Oct.—29th Oct., The Imperial Fruit Show.

1933—

20th Feb.—3rd March, The British Industries Fair.

(b) Shop premises in Sheffield and Cardiff were leased by the Board during the undermentioned periods and temporarily converted into Empire Shops. These were placed at the disposal of the various Empire countries in turn for a fortnight each, to make displays and sell samples of their products. These shops have proved very popular with the public. They have been found a useful means of enlisting the interest of local traders in a wide range of Empire products. The Board is in each case much indebted to the civic authorities, the local trade organisations and the local press for their very generous support.

1932-1933—

Sheffield, 2nd May—3rd Sept.
Cardiff, 26th Sept.—11th Feb.

(c) The Board has also been associated with a series of fortnightly exhibitions, accommodation for which was generously provided by the Overseas League at their Scottish headquarters in Edinburgh. One of these exhibitions comprised a display of the Board's publicity material; the others in the series (arranged direct between the

Overseas League and the representatives in London of the Empire countries concerned) were devoted to displays of the products of a number of individual Empire countries. These displays were very well attended by the public and were the subject of much favourable comment in the Scottish press.

(d) The Board assisted in Empire Shopping Weeks in the following centres :—

Abertillery	Chatham	Ossett
Aldershot	Chingford	Rochester
Barnes	Chiswick and	Rochdale
Belfast	Brentford	Slough
Bingley (Yorks)	Dorking	Southall-Norwood
Blaenavon	Epsom	Southend and
Brighton and Hove	Gillingham	Westcliff
Bristol	Leicester	Staines
Bromley (Kent)	Maidenhead	Stowmarket
Camborne	Northampton	Worcester

HORTICULTURAL DISPLAYS

The Board again co-operated with H.M. Office of Works in the organisation of displays of British grown bulbs and plants in the Royal Parks.

(a) *Tulips and Lilies*

For the sixth year in succession home grown tulips were the main feature of the spring bedding scheme in Hyde Park and St. James's Park. Later in the summer there was a display of Bermuda lilies in Hyde Park which was made possible by a further gift of bulbs from the Bermudan Department of Agriculture. This was followed by a small show of the same type of lily grown from bulbs raised in South Africa. The climate of South Africa has been found very favourable to the cultivation of *Lilium Harrissii*. Bulbs from Bermuda flower in June, but bulbs of the same lily from South Africa mature later and flower in September. If, therefore, the trials at present proceeding with South African bulbs yield satisfactory results the out-of-door season for these flowers will be considerably extended.

(b) *Daffodils*

Arrangements were completed in the autumn for a display this spring of 30,000 British grown daffodils in the Victoria Tower Gardens near the Houses of Parliament. The bulbs were generously provided by the Spalding Bulb Growers' Association without charge to public funds.

(c) *Roses*

The British Rose Growers' Association has made, through the Board, a further gift of four thousand rose trees to enable the design of the new British Rose Garden in the Inner Circle Gardens, Regents Park, to be extended and completed in time for the second year's flowering season. The garden was opened to the public last June and was visited by H.M. The Queen and by many thousands of visitors.

(d) *Registers of Growers*

The Board has compiled and issued a Register of British Bulb Growers and Suppliers (both wholesale and retail) and a list of British Rose Growers and named varieties of roses.

CINEMA

(a) *Film Production*

The Board's Film Unit has completed the following films in two-reel form for theatrical circulation :—

Upstream (Scots Salmon).

O'er Hill and Dale (The Lambing Season in Scotland).

Industrial Britain (The Craftmanship in Industry).

The Country Comes to Town (Home Milk Production, Market Gardening, etc.).

King Log (Lumbering in Canada).

The Other Half of the World (The Industries of the Eastern Empire).

Shadow on the Mountain (Grass Breeding Experiments at the Welsh Plant Breeding Station at Aberystwyth and on the slopes of Plinlimmon).

Line Fishing (Deep Sea Line Fishing).

The first seven of the above films have been purchased by a commercial company in their silent form, for subsequent synchronisation and distribution in public cinemas. "Line Fishing" awaits synchronisation.

Amongst other production activities undertaken during the year the following are worthy of special mention :—

(i) By courtesy of the Admiralty one of the Board's producers accompanied the surveying expedition of H.M.S. "Challenger" to Labrador last summer. The film so obtained is noted below under the title of "Uncharted Waters."

(ii) The Board was given special facilities for sending a producer on a tour of the West Indies during the Winter and Spring of this year.

(iii) A film record, described below as "Transport Train," has been prepared of the first Unit designed by the Mechanical Transport Council undergoing trials at Farnborough. The Board has offered to circulate copies of this film to the 21 oversea Governments which have joined with it in financing the construction of this Unit.

For use by schools and for other non-theatrical circulation the Film Unit has prepared the following films. Although some of the subjects represent direct E.M.B. production, many of them have been re-edited from material kindly placed at the Board's disposal by a number of oversea Empire Governments or obtained from other sources.

Empire (General)

Transport Train.
Children of the Empire.
Plants and Altitudes.
Animals of the Empire.
Wheatfields of the Empire.
Irrigation.

United Kingdom

Exports of Northern Ireland.
The Hen Woman (Northern Ireland Poultry).
Aircraft Engines.
The English Potter.
Cocoa and Chocolate.
Steel Wire and Nails.
The Glassblower.
St. James's Park.
A Cattle Auction in the Hebrides.
Britain's Countryside.

Underground (Coal Mining).
Iron and Steel.
Cotton and Wool.
The Fens.
Winter on the Farm.
Sheep Shearing.
Canals.
Drifting.
Line Fishing.
Bag Net Fishing.
The Shepherd.
Seasons.
Water Power.
Hop Gardens of Kent.

Canada

The Great St. Lawrence.
Arctic.
Eskimo Village.
Conquest of Natural Barriers.
Buy from Canada (A short "Abstract" advertising film).

Australia

Regions of Australia.
Round Up (Cattle).
Australian Sheep.

Africa

Farming in South Africa.
Regions of Africa.
East Africa.

Newfoundland

Uncharted Waters.

Gibraltar

Gateway to the East.

Apart from the Board's own productions the following films have been produced for and at the charges of other Government Departments:—

Ministry of Agriculture and Fisheries: Plums that Please.

Post Office Telephone Service: The Coming of the Dial.
Faraday House. Telephone Abstract. Telephone Service.

(b) *Film Library*

The Board's Film Library has, during the year, been considerably enlarged. Many new subjects and a number of extra prints have been made available. Some of the new films were prepared by the Film Unit but many of them have been presented to the Library by the Dominion Governments, the Canadian National Railways and other organisations.

The following statistics illustrate the growth of that service.

Films available			
	1931		1932
	189 prints of 105 subjects.		630 prints of 235 subjects.
No. of Bookings, Films Supplied and Total Audiences			
	Bookings	Films	Estimated Audiences
1931-32	947	2,156	300,000
1932-33	3,706	8,479	960,000

It will be seen that during the year the Library has been more than trebled; but, even with this appreciable enlargement, considerable difficulty has been experienced in meeting the demands which have been received. Three hundred additional organisations have made use of the Library and the Board's films have been seen by nearly a million people. If to this figure is added the attendance of 161,000 at the Board's Cinema at the Imperial Institute, the total non-theatrical audience reached by the Board during the year is well over one million. An analysis of the users of the Library shows that some 70 per cent. of them are schools.

In August, 1932, a second edition of the Catalogue of Films was issued and was followed by the issue in February, 1933, of a Supplementary Catalogue of additional subjects available.

(c) *E.M.B. Cinema at the Imperial Institute*

The Board has continued to maintain a Cinema at the Imperial Institute in which Empire films are shown daily. During the year 161,000 persons visited the Cinema, including 67,750 school children in organised parties.

APPENDIX I

(1) THE EMPIRE MARKETING BOARD

- The Secretary of State for Dominion Affairs
(The Rt. Hon. J. H. THOMAS, M.P.) (*Chairman*).
- The Parliamentary Under-Secretary of State for Dominion Affairs
(Mr. MALCOLM MACDONALD, M.P.) (*Vice-Chairman*).
- The Financial Secretary to the Treasury
(Mr. L. HORE-BELISHA, M.P.).
- The Parliamentary Secretary to the Ministry of Agriculture and Fisheries
(The Rt. Hon. the EARL DE LA WARR).
- The Parliamentary Under-Secretary of State for Scotland
(Mr. A. N. SKELTON, M.P.).
- The Parliamentary Under-Secretary of State for the Colonies
(The Rt. Hon. the EARL OF PLYMOUTH).
- The Rt. Hon. L. S. AMERY, M.P.
- Mr. W. LUNN, M.P.
- Major GWILYM LLOYD GEORGE, M.P.
- Sir EDWARD CROWE, K.C.M.G.
(Comptroller-General of the Department of Overseas Trade).
- Sir THOMAS ALLEN (United Kingdom).
- Sir WILLIAM CRAWFORD, K.B.E. (United Kingdom).
- Mr. HARRISON WATSON (Canada).
- Mr. F. L. McDUGALL, C.M.G. (Australia).
- Mr. R. S. FORSYTH, C.M.G. (New Zealand).
- Mr. J. DIMOND (Union of South Africa).
- Mr. J. W. DULANTY, C.B., C.B.E. (Irish Free State).
- Mr. H. A. F. LINDSAY, C.I.E., C.B.E., I.C.S. (India).
- Hon. J. W. DOWNIE, C.M.G. (Southern Rhodesia).
- Sir EDWARD DAVSON, Bart. (Colonies and Protectorates).

-
- SIR STEPHEN TALLENTS, K.C.M.G., C.B., C.B.E. (*Secretary*).
- Mr. E. M. H. LLOYD (*Assistant Secretary*).

(2) THE RESEARCH GRANTS COMMITTEE

- The Rt. Hon. the EARL OF PLYMOUTH
(Parliamentary Under-Secretary of State for the Colonies) (*Chairman*).
Mr. MALCOLM MACDONALD, M.P.
(Parliamentary Under-Secretary of State for Dominion Affairs).
The Rt. Hon. the EARL DE LA WARR
(Parliamentary Secretary to the Ministry of Agriculture and Fisheries).
Mr. L. HORE-BELISHA, M.P.
(Financial Secretary to the Treasury).
Mr. HARRISON WATSON.
Mr. F. L. McDougall, C.M.G.
Mr. H. A. F. LINDSAY, C.I.E., C.B.E., I.C.S.
Sir EDWARD DAVSON, Bart.
Sir BASIL P. BLACKETT, K.C.B., K.C.S.I.
(Chairman of the Colonial Development Advisory Committee).
Dr. T. DRUMMOND SHIELS, M.C.
Mr. C. L. STOCKS (H.M. Treasury).
Mrs. MAY MELLANBY.
Mr. E. M. H. LLOYD (*Secretary*).

(3) THE PUBLICITY COMMITTEE

- Mr. MALCOLM MACDONALD, M.P.
(Parliamentary Under-Secretary of State for Dominion Affairs) (*Chairman*).
Sir WILLIAM CRAWFORD, K.B.E.
(Governing Director of Messrs. W. S. Crawford, Ltd.) (*Vice-Chairman*).
The Rt. Hon. the EARL DE LA WARR
(Parliamentary Secretary to the Ministry of Agriculture and Fisheries).
Sir THOMAS ALLEN
(Director, Co-operative Wholesale Society).
Sir WOODMAN BURBIDGE, Bart., C.B.E.
(Chairman and Managing Director of Messrs. Harrods, Ltd.).
The Viscount BURNHAM, G.C.M.G., C.H.
Mr. E. R. EDDISON, C.B., C.M.G.
(Deputy Comptroller-General of the Department of Overseas Trade).
Mr. L. HORE-BELISHA, M.P.
(Financial Secretary to the Treasury).
Mrs. COTTRELL
(Director of the Co-operative Wholesale Society, Ltd.).
Mr. J. W. DULANTY, C.B., C.B.E.
Lieut.-Gen. Sir WILLIAM FURSE, K.C.B., D.S.O.
(Director of the Imperial Institute).
Mr. D. G. GERAHTY
(Director of Publicity for Canada in the United Kingdom).
Mr. W. LUNN, M.P.
Mr. H. S. MALIK, I.C.S.
(Deputy Trade Commissioner for India).
Mr. F. L. McDougall, C.M.G.
Mr. A. P. RYAN
(Publicity Manager, Gas Light & Coke Co.).

Lieut.-Col. N. G. SCORGIE, C.B.E., M.V.O.
(Deputy Controller of H.M. Stationery Office).
Mr. J. C. STOBART
(Director of Education of the British Broadcasting Corporation).

Mr. P. J. EATON (*Secretary*).

(4) THE MARKETING COMMITTEE

Mr. A. N. SKELTON, M.P.
(Parliamentary Under-Secretary of State for Scotland) (*Chairman*).
Mr. R. S. FORSYTH, C.M.G.
(London Manager, New Zealand Meat Producers' Board) (*Vice-Chairman*).
Sir THOMAS ALLEN
(Director, Co-operative Wholesale Society, Ltd.).
Mr. A. T. BRENNAN
(Assistant Trade Commissioner, Union of South Africa).
Sir THOMAS CLEMENT, K.B.E.
(Chairman and Joint Managing Director, Messrs. Andrew Clement & Sons, Ltd.)
Sir WILLIAM CRAWFORD, K.B.E.
(Governing Director, Messrs. W. S. Crawford, Ltd.).
Mr. RHYS J. DAVIES, M.P.
The Rt. Hon. the EARL DE LA WARR
(Parliamentary Secretary to the Ministry of Agriculture and Fisheries).
Mr. J. W. DULANTY, C.B., C.B.E.
(High Commissioner for the Irish Free State).
Mr. J. H. ENGLISH
(Canadian Government Trade Commissioner).
Mr. V. JOSEPH.
(Messrs. J. Lyons & Co., Ltd.).
Mr. T. W. KING, C.B.E.
(Director and General Manager, Civil Service Supply Association, Ltd.).
Mr. F. W. MACKINNEY, C.B.E.
(Chief Officer of Supplies, London County Council).
Mrs. MURIEL E. W. NICHOL
Mr. I. M. SIEFF
(Vice-Chairman and Joint Assistant Managing Director, Messrs. Marks and
Spencer, Ltd.).
Mr. W. NORMAN VERNON
(Director, Messrs. Spillers, Ltd.).

Mr. LACHLAN MACLEAN, O.B.E. (*Secretary*).

(5) FILM COMMITTEE

Mr. MALCOLM MACDONALD, M.P. (*Chairman*).
Mr. P. W. L. ASHLEY, C.B.
Mr. L. BROWETT, C.B., C.B.E. (Board of Trade).
Sir WILLIAM CRAWFORD, K.B.E.
Major The Right Hon. WALTER E. ELLIOT, M.C., M.P. (Minister of Agriculture and Fisheries).
Lieut.-Gen. Sir WILLIAM FURSE, K.C.B., D.S.O. (Director of the Imperial Institute).
Mr. L. HORE-BELISHA, M.P.
Mr. W. LUNN, M.P.
The Hon. Mrs. ALFRED LYTTLETON, G.B.E., J.P.
Mr. H. S. MALIK, I.C.S.
Mr. F. L. McDougall, C.M.G.
Mr. H. VISCHER, C.B.E. (Colonial Office).
Mr. HARRISON WATSON.

Mr. S. J. FLETCHER (*Secretary*).

(6) AGRICULTURAL ECONOMICS COMMITTEE

Mr. F. L. McDougall, C.M.G. (*Chairman*).
Sir DAVID CHADWICK, C.S.I., C.I.E. (Secretary, Imperial Economic Committee).
Mr. HENRY CLAY.
Mr. H. M. CONACHER (Department of Agriculture for Scotland).
Mr. R. R. ENFIELD (Ministry of Agriculture and Fisheries).
Professor R. B. FORRESTER (University College of Wales, Aberystwyth).
Mr. H. D. HENDERSON (Economic Advisory Council).
Mr. H. A. F. LINDSAY, C.I.E., C.B.E., I.C.S.
Mr. E. M. H. LLOYD.
Mr. J. P. MAXTON (Agricultural Economics Research Institute, Oxford).
Mr. C. S. ORWIN (Director, Agricultural Economics Research Institute, Oxford).
Dr. J. A. VENN (President of Queen's College, University of Cambridge).
Mr. K. WALTER (Horace Plunkett Foundation).

Mr. F. GRANT, M.B.E. (*Secretary*).

(7) FOOD PRODUCTS COMMITTEE

Mr. A. N. Skelton, M.P. (Parliamentary Under-Secretary of State for Scotland) (*Chairman*); Sir Thomas Clement, K.B.E. (Chairman and Joint Managing Director, Messrs. Andrew Clement & Sons, Ltd.) (*Vice-Chairman*); Mr. C. L. T. Beeching, O.B.E., F.G.I. (Secretary, The Institute of Certificated Grocers); The Hon. Algernon Borthwick (Director, Messrs. Thomas Borthwick & Sons, Ltd.); Mr. W. Collins (Principal Assistant, Supplies Department, London County Council); Mr. A. C. Coltman (Managing Director, Messrs. Anderson & Coltman, Ltd.); Mr. E. T. Dottridge, C.B.E. (Chairman, Messrs. Joseph Travers & Sons, Ltd.); Mr. R. S. Forsyth, C.M.G. (London Manager, New Zealand Meat Producers' Board); Mr. M. W. Gordon, J.P., F.G.I. (Chairman and Managing Director, Messrs. Gordon, McDonald & Co., Ltd.); Mr. A. Greig, F.G.I. (Managing Director, Allied Suppliers, Ltd., etc. and President (Grocery Section) the United Kingdom Association of Multiple Shop Proprietors); Mr. T. H. Harvey, O.B.E. (Managing Director, The United Yeast Co., Ltd.); Mr. H. A. Hughes, F.G.I. (Director, Messrs. Alfred Hughes & Sons, Ltd., etc.); Mr. V. Joseph, F.G.I. (Messrs. J. Lyons & Co., Ltd.); Mr. J. W. Justham (The Co-operative Wholesale Society, Ltd.); Mr. T. W. King, C.B.E. (Director and General Manager, Civil Service Supply Association, Ltd.); Mr. E. M. H. Lloyd; Mr. P. Machin (Director, Messrs. Samuel Hanson & Son); Mr. L. Maclean, O.B.E.; Major J. S. Mason (Managing Director, Messrs. Brand & Co., Ltd.); Major E. G. Monro, O.B.E., T.D. (Joint Managing Director, Messrs. George Monro, Ltd.); Major J. G. Stokes (Managing Director, Messrs. Salter & Stokes, Ltd., etc.); Mr. W. W. Waite (Chairman and Managing Director, Messrs. Waitrose, Ltd.); Mr. H. L. Webb (late Director, The Webb Grain Co., Ltd.); Mr. T. F. Skilton (*Secretary*).

(8) FRUITS COMMITTEE

Mr. E. M. H. Lloyd (*Chairman*); Sir E. Davson, Bart.; Mr. J. Dimond; Mr. G. M. Dykes (South African Co-operative Deciduous Fruit Exchange, Ltd.); Mr. F. C. Faraker (Australian Government Commercial Representative); Mr. H. W. Goodall, F.I.S.A. (National Federation of Fruit and Potato Trades Associations (Incorporated), Ltd.); Mr. A. E. Gough, O.B.E. (Overseas Farmers' Co-operative Federations, Ltd.); Mr. F. Grant, M.B.E.; Mr. B. W. Harlow (South African Co-operative Citrus Exchange, Ltd.); Mr. C. H. Lewis, O.B.E. (Mil.) (Representative of the National Federation of Fruit and Potato Trades Associations (Incorporated), Ltd.); Mr. L. Maclean, O.B.E.; Mr. H. S. Malik, I.C.S.; Major E. G. Monro, O.B.E., T.D.; Mr. J. Forsyth Smith (Canadian Government Fruit Trade Commissioner); Mr. H. V. Taylor, O.B.E. (Ministry of Agriculture and Fisheries); Mr. H. Turner (New Zealand Fruit Board); Dr. C. West (Cambridge Low Temperature Research Station, Department of Scientific and Industrial Research); Mr. J. W. White, O.B.E. (Representative of the Fruit Brokers' Federation of Great Britain); Mr. N. L. Wright (Scientific Liaison Officer, New Zealand); Sir William Hardy F.R.S. (Director of Food Investigation, Department of Scientific and Industrial Research) (Assessor); Mr. W. E. Knox (*Secretary*).

(9) DAIRY RESEARCH COMMITTEE

Professor H. D. Kay, Ph.D., D.Sc. (Director of the National Institute for Research in Dairying, University of Reading) (*Chairman*); Mr. J. F. Blackshaw, O.B.E. (Ministry of Agriculture and Fisheries); Professor R. H. Leitch, M.A., B.Sc., N.D.A., N.D.D. (West of Scotland Agricultural College and Department of Agriculture for Scotland); Mr. N. C. Wright, M.A., Ph.D. (Hannah Dairy Research Institute, Scotland); Mr. A. T. R. Mattick, Ph.D., B.Sc. (National Institute for Research in Dairying, University of Reading); Mr. R. H. Wilkinson, (Ministry of Agriculture, Northern Ireland); Mr. W. A. Wilson (Canadian Government Animal Products Trade Commissioner); Mr. M. Wallace (Australian Commonwealth Dairy Officer); Mr. W. Wright (Inspector of New Zealand Dairy Products); Mr. J. Dimond; Mr. A. Poole-Wilson, M.B.E. (Department of Agriculture, Irish Free State); Mr. E. M. H. Lloyd; Mr. A. More, A.R.C.S., F.I.C. (Government Chemists' Department); Mr. V. Stott, B.A., F.Inst.P. (National Physical Laboratory); Mr. A. J. Smith, Ph.D. (Cambridge Low Temperature Research Station); Mr. H. J. Denham, M.A., D.Sc. (Institute of Agricultural Engineering, Oxford); Professor G. S. Wilson, M.D., F.R.C.P., D.P.H. (London School of Hygiene and Tropical Medicine—nominated by the Medical Research Council); Mr. R. F. Jenkins (*Secretary*).

(10) SUB-COMMITTEE ON THE STANDARDISATION OF VOLUMETRIC GLASSWARE

(OF THE DAIRY RESEARCH COMMITTEE)

Mr. V. Stott, B.A., F.Inst.P. (National Physical Laboratory) (*Chairman*); Captain J. Golding, D.S.O., F.I.C. (National Institute for Research in Dairying, University of Reading); Mr. J. Davies (representing the Joint Committee for the Standardisation of Scientific Glassware); Mr. J. D. Roberts, B.Sc. (representing the Society of Public Analysts); Mr. J. Tavroges, B.Sc., F.I.C. (Messrs. Cow & Gate, Ltd.); Mr. W. Wright (Inspector of New Zealand Dairy Products); Mr. R. F. Jenkins (*Secretary*).

(11) INFESTATION OF STORED PRODUCTS COMMITTEE

Mr. E. M. H. Lloyd (*Chairman*); Professor V. H. Blackman, Sc.D., F.R.S. (Imperial College of Science); Mr. H. Brown, O.B.E. (Imperial Institute); Dr. E. J. Butler, C.I.E., F.R.S. (Imperial Mycological Institute); Dr. W. R. Thompson, F.R.S. (Imperial Institute of Entomology); Dr. P. A. Buxton (London School of Hygiene and Tropical Medicine); Mr. J. C. F. Fryer, O.B.E. (Ministry of Agriculture and Fisheries); Mr. F. Laing (Natural History Department, British Museum); Mr. T. W. Macara (British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades); Mr. H. C. Sampson, C.I.E. (Royal Botanic Gardens, Kew); Professor J. W. Munro, M.A., D.Sc. (Imperial College of Science); Dr. A. B. P. Page (Imperial College of Science); Mr. C. H. Wake (*Secretary*).

(12) RETAIL GROCERS' ADVISORY SUB-COMMITTEE
(OF THE MARKETING COMMITTEE)

Mr. Lachlan Maclean, O.B.E., Hon. F.G.I. (*Chairman*); Mr. W. Barrett, F.G.I. (Greater London Council of Grocers' Associations); Councillor J. E. Bennett, F.G.I. (Sheffield); Mr. Felix J. Blakemore, O.B.E., J.P., F.G.I. (Wolverhampton); Mr. G. Bolton (Birmingham); Mr. S. Brown (Belfast); Mr. C. O. Burrows, F.G.I. (Kingston-on-Thames); Mr. Duncan Cameron, J.P. (Alloa Co-operative Society); Councillor J. T. Clark, F.G.I. (Darwen); Mr. A. H. Clarke; Mr. J. W. Fletcher, F.G.I. (Birmingham Co-operative Society, Ltd.); Mr. W. J. Guilford, F.G.I. (Messrs. Selfridge & Co., Ltd.); Mr. C. W. Hewitt (Ipswich); Mr. A. E. James, F.G.I. (Cardiff); Mr. R. C. D. Jenkins (Messrs. Nicholl's Stores, Kensington); Mr. W. Herman Kent, Hon. F.G.I. (Federation of Grocers' Associations of the United Kingdom); Mr. John Thomson, F.G.I. (Scottish Federation of Grocers' Associations); Mr. W. W. Waite, F.G.I. (Institute of Certificated Grocers); Mr. J. N. Webster, F.G.I. (London Co-operative Society, Ltd.); Mr. Thomas Wilkie, J.P., F.G.I. (Glasgow); Mr. W. A. Yeoman (Brighton); Mr. T. F. Skilton (*Secretary*).

(13) RETAIL FRUITERERS' ADVISORY SUB-COMMITTEE
(OF THE MARKETING COMMITTEE)

Mr. Lachlan Maclean, O.B.E. (*Chairman*); Mr. L. C. Bignall (Nottingham); Mr. G. E. Bousfield (Liverpool); Mr. A. H. Clarke; Mr. R. Martin Cowley, O.B.E. (The National Federation of Retail Fruiterers, Florists and Fishmongers, Ltd.); Mr. G. Green (Belfast); Councillor G. Hall (Manchester); Mr. R. Hayward (The Retail Fruiterers' and Florists' Association, Ltd.); Mr. Victor Joseph (Messrs. J. Lyons & Co., Ltd.); Mr. J. S. Metcalf (The National Federation of Retail Fruiterers, Florists and Fishmongers, Ltd.); Mr. H. Payne (Maidstone); Mr. G. C. Salmon (Co-operative Wholesale Society, Ltd., Reading); Mr. W. B. Shearn (London); Mr. J. J. Slater (Sheffield); Mr. T. Sowerby (Darlington); Mr. T. Ward (London); Mr. W. J. Whittle (Weymouth); Mr. James K. Wilson (Glasgow); Mr. W. J. Yeoman (The Retail Fruiterers' and Florists' Association, Ltd.); Mr. C. H. Young (York); Mr. T. F. Skilton (*Secretary*).

(14) RETAIL BAKERS' AND CONFECTIONERS' ADVISORY SUB-COMMITTEE
(OF THE MARKETING COMMITTEE)

Mr. Lachlan Maclean, O.B.E. (*Chairman*); Mr. H. Bamford (London Master Bakers' and Confectioners' Protection Society); Mr. W. Banfield, M.P., J.P. (Amalgamated Union of Operative Bakers, Confectioners and Allied Workers); Mr. S. Brookes (Manchester); Mr. A. H. Clarke; Mr. J. Clarke, O.B.E., J.P., F.G.I., (Sale, Cheshire); Provost D. Fisher, M.B.E., J.P., F.G.I. (Hawick, N.B.); Mr. J. W. Gillmour (Belfast Master Bakers' Association); Mr. T. H. Harvey, O.B.E. (Managing Director, The United Yeast Co., Ltd.); Mr. Howard A. Hughes, F.G.I. (Director, Messrs. Alfred Hughes & Sons, Ltd., etc.); Mr. A. B. Hutchison, J.P. (Scottish Association of Master Bakers); Mr. F. James (Incorporated Society of Principal Wholesale and Retail Bakers, Ltd.); Mr. A. Joyce (Kettering Industrial Co-operative Society, Ltd.); Mr. J. J. N. Mackman (Hull); Mr. J. H. Merrett (National Association of Master Bakers, Confectioners and Caterers); Mr. E. F. Mitchell (National Federation of Bakery Students' Societies); Mr. F. Newens (British Confectioners' Association); Sir Robert Stewart (Scottish Co-operative Wholesale Society, Ltd.); Mr. A. Valentine, F.G.I. (Northampton); Mr. T. F. Skilton (*Secretary*).

(15) EDUCATION SUB-COMMITTEE
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SISAL

Note on the Attributes of the Fibre and their Industrial Significance

BY

S. G. BARKER, Ph.D., D.I.C., F.Inst.P., M.I.Chem.E., F.R.S.E.,
F.Z.S., F.T.I.

Director of Research, Wool Industries Research Association



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PREFACE

In their Twenty-Fourth Report dealing with the Preparing for Market and Marketing of Hemp Fibres, which was issued in 1932, the Imperial Economic Committee drew attention to the paucity of scientific knowledge concerning the sisal plant and its economic exploitation. The need for further research was indicated, and the Committee advocated that all possible support should be given to proposals for long range research.

The depression in the Sisal Industry has led to an examination of the possibilities of developing new industrial uses for sisal fibre, and has emphasized the necessity of considering research work in connection with utilisation as well as research into problems of the producers. It is now clear that any programme for research for the sisal industry should not be confined solely to growers' problems but that a more comprehensive programme, serving to bridge the gap between producer and manufacturer, is necessary if the best interests of the industry are to be served.

In the present memorandum dealing with the attributes of sisal and their industrial significance, Dr. S. G. Barker, Director of Research for the Wool Industries Research Association, summarizes the information available on the structure and chemical and physical properties of sisal fibre, and indicates the directions in which research has hitherto taken place. The significance of sisal fibre from an industrial point of view has also been set out, and some directions in which new uses might develop discussed.

The first half of the memorandum contains a detailed review of the origin, composition, and structure of the plant and its fibre, and emphasizes certain of the important characteristics of the fibre. The second half is devoted to a study of the commercial applications and uses of sisal. Reference is made to the report, published in the Bulletin of the Imperial Institute (Vol. XXXI, No. 1 1933) of the trials carried out by the Admiralty with sisal cordage, to the encouraging results which were obtained, and to the various methods hitherto employed to effect a reduction of the defects recorded during these trials.

The memorandum concludes with an account of further industrial uses which may be found for sisal, including its employment as an admixture with plastics, and emphasizes that its utilisation in several directions by important industries in this country or abroad has not developed equally with the progress which has been made with production. That a wider field for utilisation should be possible is clearly indicated, and I am therefore confident that this memorandum, which collects together and summarizes the scattered scientific knowledge concerning sisal fibre, should prove of the greatest interest and value to both producers of the fibre and to manufacturers within the Empire. It is to be hoped that it may coincide with the turning point in the depression through which the Empire's important sisal industry has been passing during the past few years.

PLYMOUTH

Chairman of the Research Grants Committee.

Empire Marketing Board,
8th May, 1933.

SISAL—A NOTE ON THE ATTRIBUTES OF THE FIBRE AND THEIR INDUSTRIAL SIGNIFICANCE

Introduction

The first essential in any study of the uses to which any textile fibre or raw material can be put, or how new uses for it may be developed, is undoubtedly a full and complete knowledge of its origin, production, constitution, structure, and their natural consequence, namely, its special properties and qualities which ensue. Further, the reactions to the various manufacturing processes, as also the precise response to chemical, mechanical or other treatment, must be known.

Textile fibres may be classified ordinarily into various sections; there being for example, the protein animal fibres, the natural carbohydrate vegetable fibres, the synthetic fibres of cellulose and their derivatives, as also mineral fibres. Animal fibres, including wool, silk, leather, feathers, etc., have been investigated scientifically in recent years by well-organised research organisations throughout the world, and as a result, the fundamental knowledge so obtained is serving as a firm foundation on which to build the industrial future, opening out possibly new uses and new methods of treatment in accordance with the developments of modern scientific industry. Whereas, in the last century, mechanical manipulation of textile fibres has been developed to the highest stage of efficiency, yet the neglect of adequate recognition of fundamentals of a chemical and physical nature, as also the lack of development along the lines of chemical and electrical engineering science, has placed these commodities in a disadvantageous position on the modern market. In cotton, wool, linen, silk, rayon, etc., i.e. the commodities in general use for clothing materials, this position is being rapidly remedied.

There remain, however, a number of fibres, known commercially as hard fibres, which possibly serve uses of a rougher nature, such as cordage, etc., which have received little or no scientific attention in the past. Of these, Coconut fibre and Sisal are but two. A previous note by the author, circulated through the Empire Marketing Board, has called attention to the position and the lack of knowledge concerning coconut fibre. An attempt was made to advocate the establishment of proper means for pursuing research in the further uses for this vast Empire product.

With regard to Sisal, the position is just as acute. In our Colonies, Dependencies, and Dominions, where these tropical plants flourish, the agriculturists have devoted themselves not only to improvement of the crops, but also by proper systems of manuring, cultivation, selection, etc., have increased the yields of the raw product and fibre. Whilst, therefore, the scientific development of production has proceeded steadily, yet on the other side, the uses for the product and true knowledge as to what it is and what it will do, seems to have been almost entirely neglected. In order to emphasise the industrial significance of the fibre, it is essential at the outset to review figures concerning Sisal exports from various parts of the world, and by the kindness of the British Empire Producers' Organisation and the Imperial Economic Committee, the following statistics have been made available :—

Exports of Agave Fibres in 1,000 tons

Producing Country.	Kind.	1927.	1928.	1929.	1930.	1931.
British East Africa ..	Sisal	49.7	53.9	62.6	67.2	72.1
Bahamas	"	0.6	0.9	0.9	0.3	—
Jamaica	"	0.2	0.3	0.4	0.1	—
Ceylon	"	0.2	—	—	—	—
Gold Coast	"	0.3	0.1	0.2	0.3	—
Total from British countries.. ..	"	51.0	55.2	64.1	67.9	72.1
Mexico	Henequen	124.9	138.0	113.9	59.4	66.2
Netherlands East Indies :—						
(1) Java and Madura	Sisal*	18.0	22.8	25.4	23.2	24.9
(2) Outer Provinces	"	28.3	27.7	33.5	42.7	45.7
Philippine Islands ..	Maguey	17.3	16.9	15.8	13.3	6.8
"	Sisal	0.2	0.1	0.1	0.2	0.1
Portuguese East Africa	"	4.1	6.0	7.3	11.4	13.6
Cuba	"	1.4	1.5	3.1	3.6	(a)
Salvador	Henequen	0.7	0.9	1.0	0.9	(a)
French West Africa ..	Sisal	0.5	0.7	0.8	0.8	1.6
Total from Foreign countries.. ..		195.4	214.6	200.9	155.5	158.7†
Total		246.4	269.8	265.0	223.4	230.8†

* Principally Sisal but also includes Manilla Hemp.

† Excluding Cuba and Salvador.

(a) Not available.

To face page 7.



FIG. I.



FIG. II.

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H.M.'s Eastern African Dependencies Trade and Information Office.

Thus we see that British East Africa alone is responsible for nearly half the world's production, and in 1931 exported 72,000 tons of fibre.

Of the Sisal coming into this country, by far the larger proportion is produced in East Africa.

The following figures supplied by W. H. Wilkinson, of Messrs. British Ropes, Ltd., from the official customs figures for imports of "hemp", show the amounts of the different cordage fibres imported into Great Britain during the last two years, and serve to show the relationship of the consumption of Sisal with the other fibres of its class.

Imports from	Chiefly.	1932.	1931.	1931.
				Retained in U.K.
		Tons.	Tons.	Tons.
Italy	Italian Hemp ..	6,221	6,094	6,089
Philippines	Manilla	22,392	43,483	35,371
East Africa	Sisal	17,003	8,945	Not available, but estimated at about 6,800
British India	Indian Hemp ..	3,286	1,765	1,019
New Zealand	New Zealand Hemp	650	417	341
Other countries (such as Hungary, Java, Mexico, etc.).	Sisal and Hemps	9,311	16,982	Not available, but on above basis would be about 15,883
	Total ..	58,863	77,686	

The figure for East African Sisal includes the amount imported into the United Kingdom from those territories adjacent to British East Africa, and for example, includes 778 tons from Portuguese East Africa in 1931.

The above table shows a very interesting rise in the importation of Sisal into Great Britain during 1932, as against 1931, thus, while the imports of manilla fell to just over half that of 1931, the Sisal imports were more than doubled. Imports of Indian and New Zealand hems increased, but not to the same proportion as those of Sisal.

The fall in the imports of manilla from the Philippines is probably due to the falling off in the requirements of the shipping industry, and to a lesser extent to the replacement of manilla, in certain cords, etc., by Sisal, caused to a large extent by its lower cost.

However, whatever the causes may be, it is clear that the proportion of Sisal in the cordage fibres imported rose considerably from 1931 to 1932.

Origin of Sources of Sisal

Sisal fibre is derived from the leaves of plants of the Agave family; members of the order Amaryllidaceae. They are indigenous to the southern and central parts of the American continent, and were first described by Clusius in 1575, under the name of aloes, an erroneous title which has frequently led to misunderstandings since the true aloe is of very different character.

A large number of Agave species have been identified and are described in the literature, and some confusion has arisen as to the exact identity of the plants normally used for the production of the fibre. This has been, in part, due to the fact that definite recognisable features of a plant undergo changes when it is grown under fresh climatic conditions. For example, the leaves of certain Agaves native to Mexico, have characteristic marginal spines, which on cultivation in Africa, gradually disappear, a change in colour also taking place. According to Michotte, the leaves of Agaves cultivated in Hawaii very quickly lose their spines. A description of the numerous varieties of the Agaves is beyond the scope of this treatise, but they are fully recorded elsewhere (e.g. Michotte, Tobler, etc.).

According to the Grey Book, No. 10, issued by the Empire Marketing Board, 1928, two species of Agave are of special commercial importance, viz. :—

Agave fourcroydes Lem. (*A. rigida* Miller, var. *elongata* Jacobi), the production of fibre from which is the principal industry of Yucatan (known as Henequen or "Mexican Sisal"). The fibre which is largely used in the United States is more brittle and less flexible than East African Sisal. It is also less white, not so well cleaned and lacks uniformity, possibly owing to variation in the species of plant cultivated.

Agave sisalana Perr. (*A. rigida* Miller var. *sisalana*). This plant, native to Central America, has been introduced into most tropical countries of both hemispheres and is extensively grown in East Africa.

Agave Cantala Rox., the Maguey plant of the Philippine Islands, which is grown to some extent in Java and India, is of less importance.

The Sisal plant has a short stem of a thickness about 15 in., from which spring upwards and outwards a number of thick rigid fleshy leaves from 4-6 ft. in length, and having a maximum breadth of 4-7 in. The leaves taper towards the apex, terminating in a long, sharp thorn. They are thickest at the base ($1\frac{1}{2}$ - $1\frac{3}{4}$ in.), where the top surface is almost flat, thinning towards the apex, the top surface becoming concave for the greater part of the length. The edges of the leaves have only a suggestion of the spines normal to the fourcroydes species.

Method of Reproduction

When the plant has attained a certain stage of growth, which represents an age of from 4 to 8 years in East Africa and as great as 15 years in Yucatan, the terminal bud at the top of the stem, which has been previously buried in the bases of the young leaves, begins to shoot a tall "pole" or flowering stem, which grows out of the centre of the plant, attaining a maximum height of 20 to 30 ft. The factors which determine the exact age of the plant at which this phenomenon takes place are not fully understood, but it is probably determined by climatic and soil conditions. After the pole appears, no more leaves are formed and the characteristic flowers are produced in dense clusters at the ends of the short lateral branches which grow out of the pole towards the top. The Sisal plant does not as a rule set seed, although plants grown at high altitudes, such as in the highlands of Kenya, do produce seeds from which plants may be grown, as has been demonstrated at the East African Agricultural Research Station at Amani. Under the usual conditions of growth, however, buds are formed in the axils of the flower stalks as the flower begins to wither. From these buds, small plants or "Bulbils" are produced with characteristic groups of leaves, which attain a length of a few inches before becoming detached from the tree and falling to the ground, where, under favourable conditions, they take root. The number of bulbils produced on one "pole" is between

two and four thousand. In cultivation, it is usual to cut the pole fairly soon after its appearance, so as to be able to reap the remaining leaves of the plant, which otherwise wither as flowering takes place.

A second method of reproduction is by the formation of suckers, which grow from the rhizome of the plant and may give rise to a ring of small plants surrounding the parent. These suckers, if detached and planted out may often grow normally, but if they remain attached to the parent have a short life, as, according to F. J. Nutman, the poling tendency of the parent plant is transmitted through the suckers and the offspring may all pole simultaneously with the parent.

It is not within the scope of this treatise to deal with the agricultural problems arising out of Sisal culture. These are fully dealt with elsewhere, e.g. amongst other places :—

- (1) Bull. of Imp. Inst. XIII (1915), No. 3.
- (2) Bull. of Imp. Inst. XXIX (1931), No. 3.
- (3) Report of Imperial Economic Committee, Hemp Fibres (1932).
- (4) Michotte, "*Agaves et Fourcroyas.*"

The plant will grow under climatic conditions very unfavourable for most other crops and in a poor soil, without any manuring, and in the presence of a limited amount of moisture, although its growth appears to be favoured by the judicious application of manures. Under conditions favouring excessive growth, the fibre content of the leaves falls very considerably ; this being due to the production of a more fleshy leaf. It is probable, however, that the increase in the rates of growth and size of the leaf more than compensates for the lower yield of fibre ; whilst conditions favourable to a greater rate of growth may possibly also be conditions favourable to the production of more flexible fibres.

Harvesting of the Leaves

The length of time which must elapse before harvesting varies in different countries. The cutting of the leaves in East Africa commences during the 4th or 5th year of growth, the oldest (lowest) leaves being cut first. In Kenya (*vide* E.M.B. report), about 70 leaves are removed at the first cutting, with subsequent bi-annual cutting of 25 leaves at a time. Each plant should thus yield 250–300 leaves

To face page 11.



FIG. III.



FIG. IV.

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during its life of 7-8 years. In Mexico, the number of leaves cut per year is only half this number, but the plant lives for 15 or more years.

The shorter duration of life of the East African plants appears not necessarily to be a disadvantage, as assuming that the number of leaves produced in the lifetime of the plant is more or less constant, there is a definite advantage in reaping the whole of the crop in a limited period of time.

It has, however, been shown that the total number of leaves produced in the life of a plant is a variable factor, the cause of variation being unknown. (Vide Hemp Report, Imperial Economic Committee.)

The average weight of the leaf varies considerably according to the habitat of the plant, but in East Africa is from 2-2½ lbs. Considerable variation in the fibre content of the leaf is recorded. It is known for example that a dry habitat is conducive to a higher yield of fibre, and for this reason the percentage yield per leaf of fibre is greater in Mexico.

Older leaves are found to contain more fibre than younger ones, but the average yield of fibre in East Africa is given as of the order of 3 per cent. to 4 per cent. on the weight of the leaf. How far the age of the plant determines the fibre content of the leaf is not defined. Tobler quotes figures due to Braun for the fibre content of leaves taken from plants, grown under identical conditions, at various stages of growth. They are as follows:—

4 years old	1·9 to 3·0	per cent.
4¾	2·8 to 4·3	„ „
5	4·5	„ „
6½	2·1 to 3·3	„ „

The figures appear to indicate an increase up to a point. The following figures are given by Michotte (loc. cit. p. 40) for the fibre contents of Agave leaves (Henequen).

Water 81·41-84·4
Dry matter 15·6-18·59
of which fibre equals 5·32 and pulp 13·27

Dried Leaves :—

Fibres 28·61 per cent.
Pulp 71·39 „ „

For *Agave Sisalana* leaves Michotte quotes the following figures for 30 leaves :—

Sisal :—

Average weight of leaf	1.2 kilos
Green fibres	5.1 „
Dry fibres	1.51 „

Yield per cent.—

in green fibres	14.2 per cent.
in dry fibres	4.19 „

Michotte further gives the following figures for the composition of the ash of leaves :—

Composition of the Ash of Leaves (1.135 per cent. on the Green Leaves).

Lime	33.40
Potash	18.80
Magnesia	15.37
Soda	1.42
Phosphoric Acid	3.29
Sulphuric Acid	0.88
Iron	0.69
Chloride	0.28
Silica	0.56
Carbonic Acid, etc.	25.31

The high percentage of calcium carbonate is largely derived from the deposits of calcium oxalate which are known to occur in the leaf.

It should be pointed out that figures giving the fibre contents of leaves are not necessarily of very great scientific value since owing to the large number of variable factors they can only be of use when they represent average figures of a very large number of experiments. The accumulated experience of a large number of growers is necessary in order to formulate any useful generalisation. Such matters could properly be dealt with by an Institution interested in research on production. During the decortication of the leaf, a considerable amount of fibre is wasted amounting possibly to from 15–30 per cent. of the total fibre, most of which is derived from the butt end of the leaf. Machines have been constructed which are able to recover this fibre but it would seem that recovery might not be economic unless prices for fibres were very high.

Distribution of the Fibres in the Leaf

The fibres which are of use commercially are the mechanical tissues of the Agave leaf. In the Monocotyledon leaves, these are associated with the vascular system and give support and protection to the water-conducting vessels of the leaf. These vascular bundles run parallel to one another and in a longitudinal direction throughout the length of the leaf. A comprehensive study of the distribution of the vascular bundles in the Sisal leaf has been made by F. Tobler of Dresden.

Tobler points out that if a transverse section of the leaf be made, the individual vascular bundles are revealed embedded in the fleshy tissue of the leaf. The shape of the section shows two long slanting sides, which constitute the under side of the leaf meeting in the thickest part which corresponds to the apex of a triangle of which the sides are all slightly curved, the curvature depending upon the point at which the leaf section is made and on the mass of the flesh of the leaf. Examination of the section shows that the bundles are not distributed absolutely irregularly over the surface. They are more numerous on the underside of the leaf, which appears to be divided into two parts by a definitely marked narrow zone which joins the two top corners of the leaf. On examination this zone appears to be produced by a local concentration in one plane of vascular bundles. As the top surface and sides of the leaf are approached, there is an increase in the frequency of the bundles, amounting, as the surface is approached, to a fusion.

From the point of view of fibre, the importance of the vascular bundle lies in the cells which surround and protect its more delicate elements. The mass of these mechanical tissues determines the diameter of the fibres. The section form of the technical fibres varies according to the bundle and the zone of the leaf through which the section is cut. The enclosed cells, the water-conducting cells and the weak protein-conveying cells, also vary in extent according to the zone of the leaf. Actually in the technical fibre these cells have largely disappeared leaving a hollow space. From the technical point of view the complete vascular bundles are of importance, and their greatest concentration is around the zone line mentioned above. Below this, interspaced between the complete vascular bundles, are a number of smaller fibre cords which do not appear to be associated with any water-conducting or other vascular elements. In the top

area of the leaf the vascular bundles are fewer and of smaller size. On decortication of the leaf, the complete vascular bundles, however, constitute the main portion of the yield of fibres, and an anatomical study of these throws much light on the cause of variation in the form of fibres from various sources.

The typical vascular bundle section shows about 10-20 vessels and a small group of delicate sieve tubes. On either side of these and diametrically opposed to each other are a group of sclerenchymatous fibres. One group of these is very much larger than the other, and below the zone line of the leaf the orientation is such that this larger group is on the lower side of the bundle (nearer to the lower surface of the leaf). Above the zone line this orientation is reversed, the larger group being on the upper side, but bundles actually on the zone line conform in disposition with those of the lower part of the leaf. These two fibre groups show marked difference both in shape and also in the nature of their individual fibre cells. This will be discussed at greater length later.

Decortication and subsequent treatment for extraction of the Fibre

The lignified nature of the fibre as also its manner of occurrence in the leaf render it particularly suitable for direct mechanical extraction and thus retting is unnecessary. Early attempts at extraction by hand were so laborious, that in spite of the cheap labour available, a prize was offered for the invention of a machine which would successfully do the work. Such a machine was invented by a Franciscan friar, who produced the first "Raspador" for mechanical extraction of Sisal in Mexico as early as 1839. It is of historic interest, in that in principle it is the basis of all subsequent machines for this purpose. Wigglesworth defines the principle as simple, in that it essentially involves "the crushing of the leaf whilst it is automatically held in its centre." The leaves are treated as soon as possible after harvesting to avoid hardening of the fleshy matter and to prevent the juices becoming dry and gummy, thus rendering subsequent fibre extraction a matter of difficulty. The modern decorticator takes the leaves direct from a conveyer or automatic feed from whence they are passed over concave saddle plates where they are stripped of fleshy matter by steel or bronze knives bolted to revolving drums. In action the machine takes the leaf from the conveyer whereupon it is carried upon the surface of a feed drum until a time arrives when whilst one end is still held by it, the other opposite end of the leaf

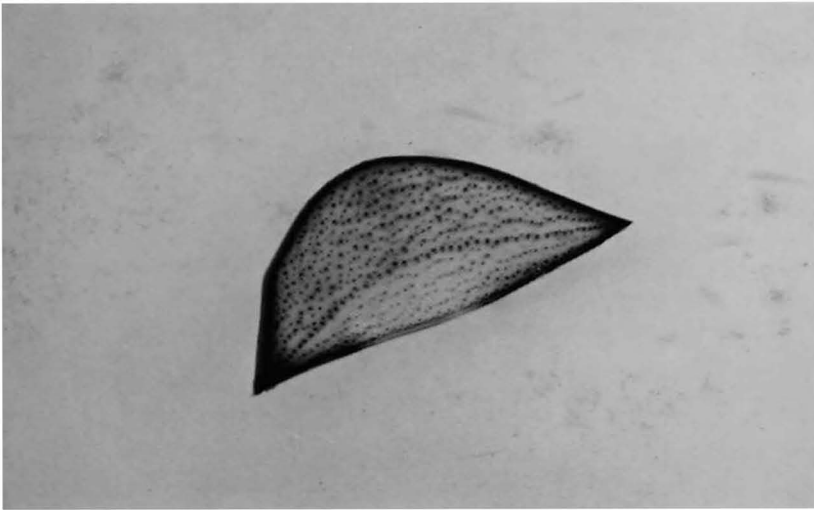
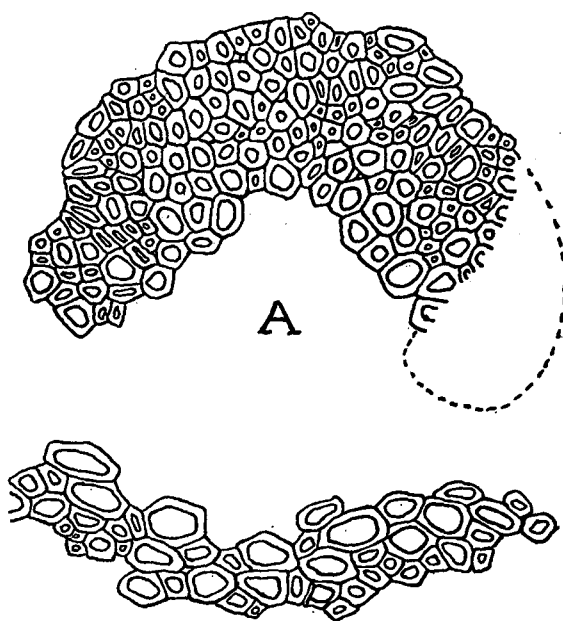


FIG. V.

**Section through a Leaf of *Agave fourcroydes*.
Two-thirds natural size.**

(*Tobler.*)

To face page 15.



B

FIG. VI.

Section of Henequen fibre.

A. The outer group.

B. The inner group.

Magnified 200 times.

(Tobler.)

meets the drum and concave of the raspador part which works at right angles to the direction of the feed drum. The pulpy matter and flesh of the leaf are stripped off, leaving only the fibre hanging down. During the whole of this operation a plentiful supply of water is played upon the decorticator, in order not only to assist the fibre to free itself from the fleshy matter in which it is embedded but at the same time to afford a simple and ready means of removal of the refuse of the decorticating operation.

At the same time, the abundance of water is said greatly to improve the colour of the extracted fibre. The suspended hank of extracted fibre passes further through the machine until it comes under the influence of a blowing device which propels the hanging hank of fibre forwards so that it next comes in contact with an arrangement for the separation of the clean and unclean portion of the leaf. The former is then delivered to the operator at the end of a conveyer chain. The most modern plant embodies a device for gripping the leaf near the butt end more effectively and is furnished with a wider drum and concave for dealing with this part of the leaf. It is claimed that about 13,000 leaves per hour can be dealt with by this machine. The finally delivered and washed fibre, kept as free from entanglement as possible, is hung out in the sun to dry, or alternatively is dried in a drier by artificial heat.

The latter process needs careful investigation for, by analogy from the experience of drying other textile fibres, which has become a matter for scientific research, optimum conditions of temperature, rate of passage through the drier, humidity of the atmosphere during drying, form of heater, etc., would call for special design to meet the requirements of the fibre in order to deliver it for manufacturing purposes exactly as required. Until more is known of the fibre itself such advice is difficult to render.

After drying, the fibre is brushed to remove any adhering pulp, to comb and straighten the fibre in the hanks, improve the lustre by polishing, remove dust and short fibre and generally improve its appearance and quality. The plant for mechanical extraction would thus appear to include as essentials (1) a decorticating machine, (2) crushing rollers (to deal with thick or hard leaves), and (3) a brushing machine ; also the necessary appliances for baling, weighing, etc., in preparation for export. It is unnecessary to describe the various types of decorticator used, as details are available in the

current publications of machinery makers for this type of work. The Bulletin of the Imperial Institute No. 3, 1915, records various types in use with a brief description of each, and this is further amplified by Tobler (1932). Amongst others it would seem that "Corona," made by Messrs. Krupp of Germany, and the "Sixdecor," made by Messrs. Robey of Lincoln, are highly popular in East Africa. Other makers such as Messrs. Lehmann of Manchester, and Messrs. Greenwood & Batley of Leeds, have their own specialities in this regard. The leaf, as already mentioned, contains only about 3 per cent. of extractable fibre, and the 97 per cent. of waste (Megasse) is at present largely unutilised. Proposals for the attainment of this end will be discussed later. In the production of Sisal fibre, Wigglesworth records that two classes of tow are also produced, the first from the brushing of the fibre, which is carded and subsequently utilised for the spinning of yarn upon machinery similar to that used for long fibre. The second type of tow is an inferior product produced during the decortication and contains barky material and is frequently discoloured. Here again is scope for research, for it has clearly been demonstrated that such tow as the first variety can be dealt with effectively on a modified flat card such as is used for cotton and can be made into a sliver direct. By softening previous to carding, a good material for various purposes is produced.

Nature of the Fibre

Sisal fibre consists of filaments of from 3-5 ft. in length. The colour of the best grades is white to pale yellow. If properly prepared it is comparatively free from adhering pulpy matter. The diameter of the fibre varies considerably from filament to filament, but the average value is usually characteristic of the grade of fibre and the district from which it is derived. Tobler (Faserforschung) has arranged the better known grades of Sisal according to their properties in the following tables: -

Colour

Java A.	..	..	..	Pure white.
Java X.	..	..	..	White.
East African	..	..	..	Not quite so white.
Java T.C.	..	..	..	Yellowish white.
Best quality Henequen	..	..	..	Yellowish.
Portuguese	..	..	..	More yellowish.
Brazilian	..	..	..	More yellowish.
Indian	..	..	..	Yellowish to yellow.
Henequen (common)	..	..	..	Yellow.

Average Length of Fibres

East African	..	..	..	137	cm.
Brazilian	..	..	..	130	"
Java Sisal A.	..	..	..	126	"
Java Sisal X.	..	..	..	126	"
Mexican	..	..	..	118	"
Portuguese	..	..	..	116	"
Java T.C.	..	..	..	111	"
Henequen, good quality	..	..	..	107	"
Indian	..	..	..	101	"

Average Thickness of Fibres

Portuguese	..	..	..	0.423	mm.
Mexican	..	..	..	0.403	"
Java A.	..	..	..	0.365	"
Indian	..	..	..	0.358	"
Henequen, good quality	..	..	..	0.343	"
Brazilian	..	..	..	0.333	"
East African	..	..	..	0.324	"
Java X.	..	..	..	0.320	"
Java T.C.	..	..	..	0.223	"

He has also determined the variation in the thickness of the fibres derived from leaves of different ages, the leaves being obtained from plants which were strictly comparable. His results do not seem to indicate very great differences in this regard, but, as will be discussed later, a microscopical examination of the section of the fibres from young and old leaves does in fact reveal differences in the structure of the cell walls.

Chemical Composition

The material of the Sisal fibre is a form of ligno-cellulose. A large amount of data upon the chemical composition of Sisal fibres has been furnished by the Imperial Institute, London, in their Bulletins No. 3, 1915, and No. 4, 1929. The method of analysis employed was similar to that of Cross and Bevan in their work upon Indian Fibres and Fibre substances. Typical values are quoted below of samples from Tanganyika, Kenya, Portuguese East Africa and

Mexico. In the table, the figures quoted represent the highest values (H), the lowest values (L), and the average for a number of samples (A).

	Tanganyika.			Kenya.			Portuguese East Africa.			Mexico.		
	High.	Low.	Average.	High.	Low.	Average.	High.	Low.	Average.	High.	Low.	Average.
Moisture	10.2	7.4	9.4	10.1	9.3	9.7	9.6	9.0	9.3	10.1	8.1	9.0
Ash	1.0	0.5	0.7	1.3	1.0	1.2	0.7	0.6	0.6	1.7	0.5	1.0
Alpha hydrolysis loss..	11.6	9.5	10.4	11.6	10.8	11.2	13.2	10.3	12.1	20.1	10.6	15.5
Beta hydrolysis loss ..	14.4	11.2	12.9	13.5	12.9	13.2	15.9	14.7	15.2	22.3	12.8	18.4
Acid (loss) purification	3.0	1.1	2.0	3.2	2.6	2.8	3.8	2.0	3.0	11.4	1.7	6.5
Water washing loss ..	2.4	0.2	1.5	2.8	2.0	2.5	3.3	1.5	2.5	11.0	1.4	6.0
Cellulose content ..	81.4	77.0	78.9	78.0	76.3	77.3	77.3	75.6	76.3	77.1	69.1	73.1

The moisture content was determined in the ordinary manner by drying at 100–110° C. and the value is expressed as a percentage of the original weight. The moisture values serve to some extent as an indication of the susceptibility of the fibre to attack by hydrolytic agencies. The ash content is determined by complete incineration of the fibre and weighing the residue. A high ash value is indicative, possibly of mineral impurity introduced during the preparation of the fibre. In the case of hydrolysis the α hydrolysis figures indicate the loss on immersion in boiling caustic soda solution of such dilution as to represent 1 per cent of Na_2O . The operation is performed in a reflux condenser for 5 minutes. The β hydrolysis is accomplished by similar immersion under like conditions to the above, only for a protracted period of one hour. Whereas in the case of α hydrolysis, the loss in weight indicates the amount of directly soluble matter extracted from the fibre by the alkali, the figures obtained for the β hydrolysis include also the amount of substance rendered soluble by the degradation of the fibre substance by the alkali. The values for the hydrolysis loss, therefore, indicate not only the susceptibility to alkaline attack, but also may be taken as an index of the ability of the fibre to resist prolonged exposure to aqueous influences or to alkaline liquids encountered during industrial processing.

The loss on acid purification obtained by slowly heating to boiling the fibre immersed in a 20 per cent. solution of acetic acid affords a measure of the quantity of casual impurities present, as also the water washing method employed which merely indicates the amount of water soluble impurities present. The cellulose evaluation was reached by boiling the fibre for five minutes in a dilute solution of caustic soda of the same strength as in the hydrolysis tests, and after removal of alkali by washing, subjecting the wet fibres to the action of chlorine gas for one hour or even longer as required. After further washing it was treated with a 3 per cent. sodium sulphite solution which was slowly heated to boiling. After two or three minutes of boiling a small quantity of cold water is added, and in a corked flask the contents are submitted to increasingly violent shaking until the fibre is broken down into its ultimate elements. After filtration and treatment with a 20 per cent. solution of acetic acid, it is washed, dried and weighed. The immersion of the chlorinated fibre in the sodium sulphite solution is accompanied by a brilliant purple or crimson coloration, if the fibre is of the ligno-cellulose type, whilst a practically colourless solution is obtained from non-lignified fibres.

The above described method of cellulose estimation aims at removal of non-cellulose matter leaving the cellulose content intact. The figure so obtained is obviously of high economic importance. In commenting upon these results, the Imperial Institute calls attention to the fact that the Tanganyika samples were least affected by hydrolysis, water washing and acid purification, and had the highest cellulose content. Kenya samples were intermediate between Tanganyika and Portuguese East Africa, whilst the Mexican samples were mostly inferior to the East African ones, owing to the large amount of impurities present and the low cellulose content. Taking the difference between the α and β hydrolysis figures as indicative of the relative stability of the fibre substance and its durability to exposure, it is interesting to compare these differences in the case of the samples examined. The following table sets the figures out clearly :—

<i>Sample.</i>	<i>Range per cent.</i>	<i>Average per cent.</i>
Tanganyika	1.7-3.8	2.5
Kenya	1.7-2.6	2.0
Portuguese E. Africa..	1.8-5.0	3.1
Mexican	1.6-5.6	2.9

The actual difference between the various samples is therefore small and would seem of small significance.

Further work on the analysis of Sisal is recorded by Michotte who quotes the following figures for the analysis of the dry fibre. His method of analysis, however, is not described.

Henequen Analysis of Dry Fibres—Weight 58.70 kgm.

Phosphoric Acid	..	..	..	0.24
Lime	..	..	..	1.14
Potash	..	..	..	0.62
Nitrogenous matter	..	..	..	1.02
Saccharifiable carbohydrates	..	..	..	5.09
Cellulose	..	..	..	25.24
Vasculose Lignin, etc.	..	..	..	22.60

The following further table of chemical analyses of Sisal carried out at the Imperial Institute, London, is available.

	Central Provinces, India.	Sahar- ampur.	Madras.	New South Wales.	Trinidad.	Bahamas.
Moisture	11.0	9.1	9.3	9.8	11.6	12.8
Ash	3.6	0.8	1.5	1.6	1.0	4.4
Alpha hydrolysis loss.	19.6	8.6	13.6	13.0	11.7	12.0
Beta hydrolysis loss.	21.9	15.1	16.9	15.0	13.5	16.1
Acid purification loss.	2.5	1.6	2.9	5.6	1.0	8.1
Mercerisation loss	12.5	12.3	10.8	12.2	8.9	13.4
Nitration increase	30.5	37.5	33.1	34.1	32.9	29.7
Cellulose	67.1	82.4	75.7	77.7	77.2	75.9

Tobler quotes a further series of values for the chemical composition of dry fibres :—

<i>Dry Fibres</i>	<i>Per cent.</i>
Mineral matters	0.96
Nitrogenous matters	0.72
Reducing sugars	Traces
Non-reducing sugars	—
Other soluble carbohydrates..	12.30
Cellulose	67.26
Vasculose lignocellulose, etc.	18.74

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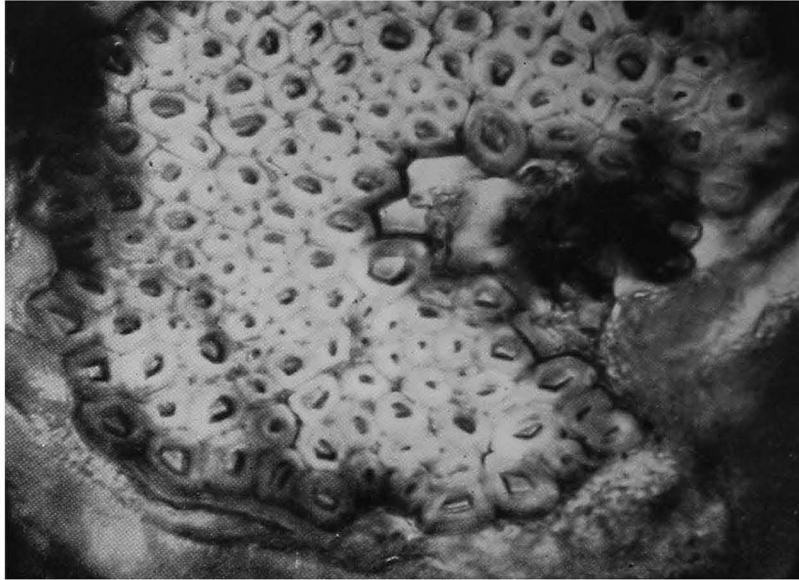


FIG. VII.
Cross section of Sisal fibre. (*Dantzer and Roehrich.*)

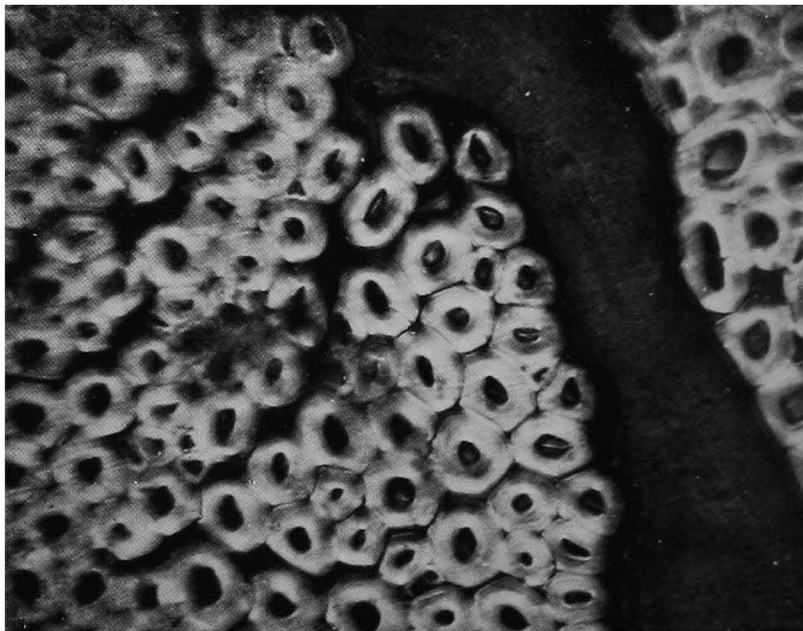


FIG. VIII.
Cross section of Manilla fibre. (*Dantzer and Roehrich.*)

Although these analytical figures may be of interest, Tobler indicates that he considers that they are of small account in assessing the commercial value of samples. This statement is probably an exaggeration, but the fact remains that samples of greatly differing commercial value may have the same content of cellulose. The difference between the alpha and beta hydrolysis values, however, may convey useful information as to the stability of the fibre substance. An intricate chemical investigation of the lignocelluloses would possibly yield significant results, especially if the analytical results so obtained could be correlated with the conditions of growth of the plant, its age, and also the age of the individual leaves when cut.

FORM OF THE FIBRE

Anatomical Investigation of Fibro-vascular Bundles

It has been mentioned that according to Tobler (Faserforschung) a microscopic examination of the section of a complete fibro-vascular bundle (a complete technical fibre) reveals that each bundle has two groups of mechanical tissues which strengthen and protect its weaker elements. The larger of these is of a horse shoe or crescent shape, and more or less surrounds the water-conducting and other vessels of the bundle, or, as these are generally absent in the technical fibres, the cavity which they have formerly occupied. The other group is more or less complementary to the first group, the two together making in some instances, a complete circle or ellipse. In the cross-section of the bundle, however, they are usually some distance apart, separated by some of the ground tissue cells of the leaf.

In the process of extraction of the fibre from the leaf these groups may or may not be separated, according to (a) the severity of the treatment, (b) their original distance apart, and (c) the strength of the intervening cellular linkage. This leads in practice to the occurrence of filaments of two distinct types. Furthermore the larger group (inner group) is itself not infrequently broken up by the processes of extraction and preparation of the fibres; that is to say the fibre is split into smaller units. Tobler has found that the origin of a Sisal fibre may often be traced by the size and shapes of these groups. Variations in the method of preparation may lead to differences in the frequency with which the different groupings may occur in a commercial sample. For example during the mechanical

processes such as brushing and washing the weaker (smaller sectioned fibres) may break up and be lost, leading to a predominance in the finished fibre of the larger groupings. There is, in addition, another remarkable difference between the two groups. The elementary fibre cells which make up the inner group are thicker in the walls and have a much narrower lumen than the fibre cells of the outer and smaller group. This difference can be seen in the Figs. VII and VIII.

Thus, in a technical sample it is possible to differentiate between fibres derived from the two groups. If the inner group has been greatly broken up by the longitudinal splitting of the fibre, this will be indicated by the frequency of small section fibres with thick walled cells with a narrow lumen.

In general it is said that for conventional usage the most desirable qualities in Sisal fibre are a solid form, and the absence of split fibres. Individual cells should be thick walled, as this is an indication of mechanical strength in the filament. Java and East African fibres appear to be the best ; they are strong owing to the definite horse shoe shape, and the small dimensions of the cavity from which the mass of the vascular tissues have been removed. An inner group which forms part of a circle of large circumference, that is to say, one which is crescent shaped rather than in the shape of a horse shoe, is much more likely to be split during the preparation of the fibre ; so that this quality and thinness of the cell walls may both be associated with the breaking up of the fibres.

Lignification of Fibres

The difference in the sections of fibres obtained from old and young leaves is interesting. Whilst it does not appear from Tobler's investigations on this point, that the plant adds additional bundles as the age of the leaf increases (the thickness of the fibres from old and new leaves being approximately the same), yet there are indications that as the age of the leaf increases the fibres become more lignified. In the section of the fibre cell this is indicated by a darkening at the points of juncture (corners) where the middle lamellae come together. This increase of lignification is the cause of brittleness in the fibres. Staining of the sections with Phloroglucin *HCl* shows a marked increase in the lignification, not only with increase in the age of the leaf, but also with increase in the age of the

plant. Thus young leaves obtained from old plants just before the poling stage yield fibres which are lignified to a considerable extent and correspondingly brittle. Working with Henequen, Tobler has shown that the shorter fibres are less lignified than the longer ones, this being due to the fact that the shorter fibres are, generally speaking, derived from the younger leaves. Since brittleness and inflexibility increase with the degree of lignification, and the spinning qualities of the fibres depend to a large extent on the degree of existence of these qualities, it is suggested that it might be advantageous for subsequent utilisation to aim at cutting the leaves as early as possible.

How far this suggestion is economically sound is another question, since it has to be demonstrated that the more flexible fibres can command a higher price in the market or are of greater utility. It is generally thought that the more a fibre is lignified the weaker it will be owing to increased brittleness.

It is stated that when a plant commences to "pole" the practice followed is to allow the remaining leaves to mature. These leaves yield "strong" fibres which are very highly lignified and correspondingly brittle. Unless, however, a grower can get a higher price for more flexible fibre obtained from less immature leaves, it is obviously in his interest to obtain as high a yield of fibre as possible, irrespective of the degree of lignification. In this connection it is interesting to note that the fibre from East African plants, which have a high rate of growth, is less brittle and more flexible than for example the fibre from Yucatan.

Structure of the Fibre

The filaments of Sisal are built up of groups of elementary fibre cells. These cells may be separated by boiling with aqueous alkalis. A section through a single filament reveals the cell structure. Hermann and Herzog (*Mikroskopische und mechanisch-technische Textiluntersuchungen*) describe the fibre cells as polygonal in shape, the corners being slightly rounded. The length is given as 1-5 mm. and the breadth 24 μ . The lumen is polygonal the corners being more rounded than those of the cell wall. The elementary fibres are rarely forked. Spiral vessels occur frequently. The walls are seldom laminated. The ash which is of a greyish white colour consists of crystals of calcium carbonate derived from calcium oxalate crystals present in the fibre and 0.5 mm. in lengths.

A similar description is given by Matthews (Textile Fibres) who gives the length of the fibrillar cells as 1.5–4 mm. and the breadth as 20–30 μ . They are described as stiff in texture and showing a remarkable thickening towards the middle. The width of the lumen is described as frequently greater than that of the cell wall. Short thick walled fibres with pointed ends are stated to occur frequently. In these the lumen is narrow and surface pores are to be noticed. Spiral shaped schlerenchymatous tissues are also common. Iodine and sulphuric acid stain the walls yellow but no median layer is revealed between the fibres. Richter has measured the breadth of the cells which he gives as on the average 21–24 μ , the walls being 6 μ and the lumen 9 μ . Richter also observed the characteristic sword-shaped ends of many of the fibres, and the thickness of the point he measured as 9 μ . According to Michotte, the cells may sometimes be lobed and sometimes forked or bifurcated. Characteristic of Sisal are groups of three fibres which are closely attached to one another and which can only be separated with difficulty, the group appearing to form one unit.

Michotte also records dimensions similar to those given by Matthews. He states that the size of the cells varies with the age of the leaf Tobler has stated that such differences are not to be observed although the appearance of the cell wall is different, being darker in the case of the older and more lignified cells. The length of the fibre cells was also determined by Dantzer and Roehrich as between 2 and 2.5 mm. The fibres give the characteristic tests for lignocellulose with aniline sulphate and with phloroglucin/*HCl*. Iodine and sulphuric acid give a bright yellow coloration. With chlorzinc iodide according to Richter they give a brown violet colour turning to violet in the course of a day, but according to Michotte a yellow coloration. They swell up slightly under the action of chromic acid and irregularly on treatment with Schweitzer's reagent.

According to Tobler, the fibre cells separated by maceration of the fibre bundles, when treated with Schweitzer's reagent swell up and show, in many cases, marked spiral rotation. Between the spiral and the primary membrane, globular swellings were to be noticed.

In the case of Henequen, the spirals were only observed with the thin-walled (narrow lumen) cells, and not under the conditions of the experiment, with the thick-walled cells. Tobler suggests this as

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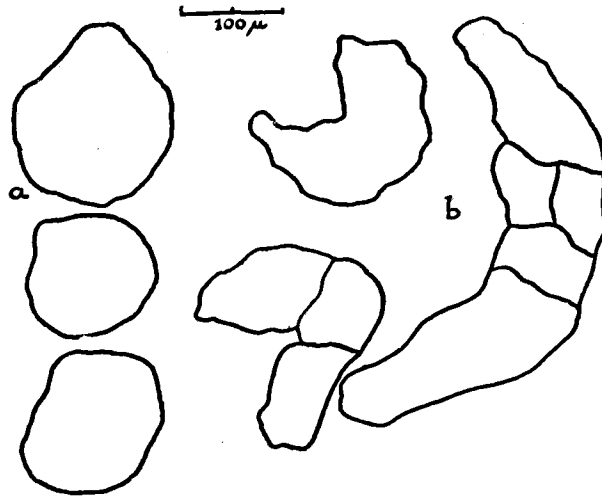


FIG. IX.
CONTOUR.
a Manilla. b Sisal.
(Dantzer and Roehrich.)

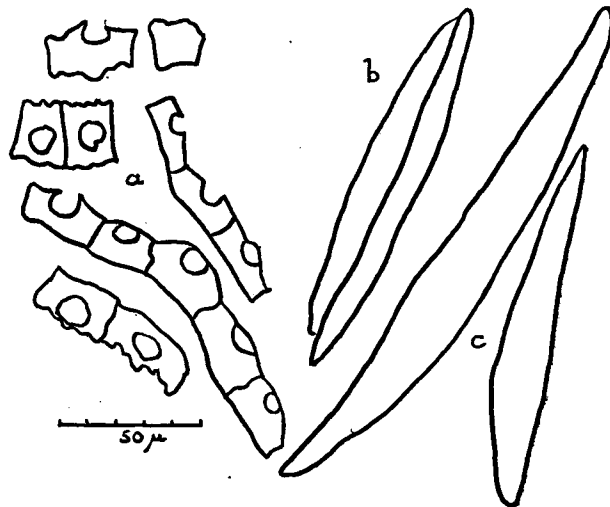


FIG. X.
FIBRILS.
a Manilla. b Mexican Sisal. c Java Sisal.
(Dantzer and Roehrich.)

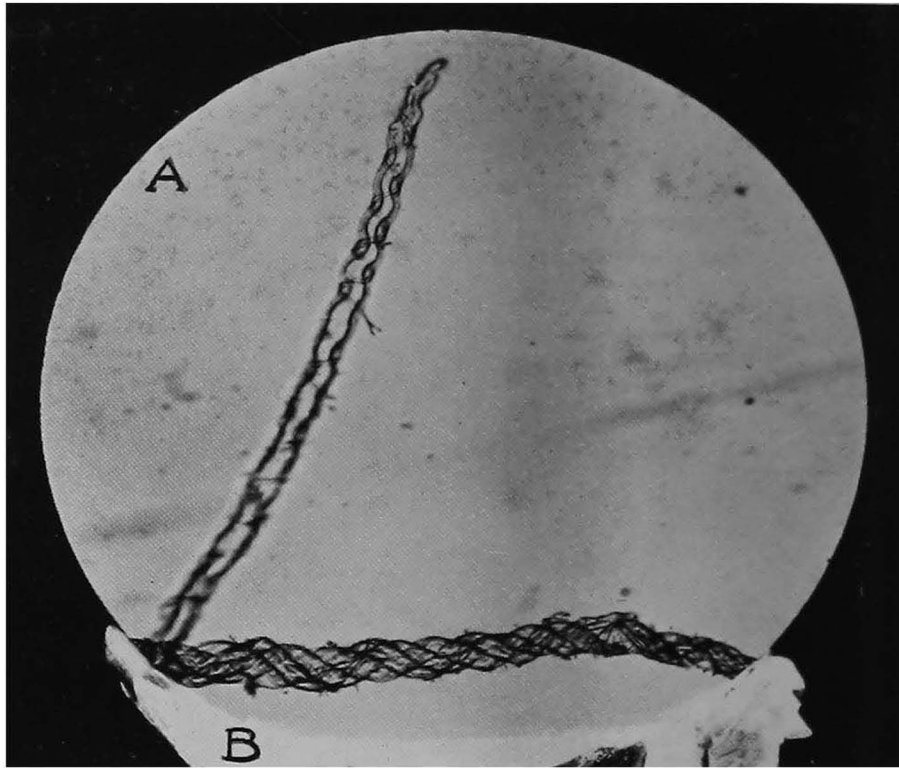


FIG. XI.

- A. Java—Sisal, single fibre macerated out of the narrow lumened fibre bundle, swollen in copper oxide/ammonia. Magnified 85 times.
- B. Java—Sisal fibres, macerated out of the wide lumened bundle (three fibres together). Swollen in copper oxide/ammonia. Magnified 85 times. (Tobler.)

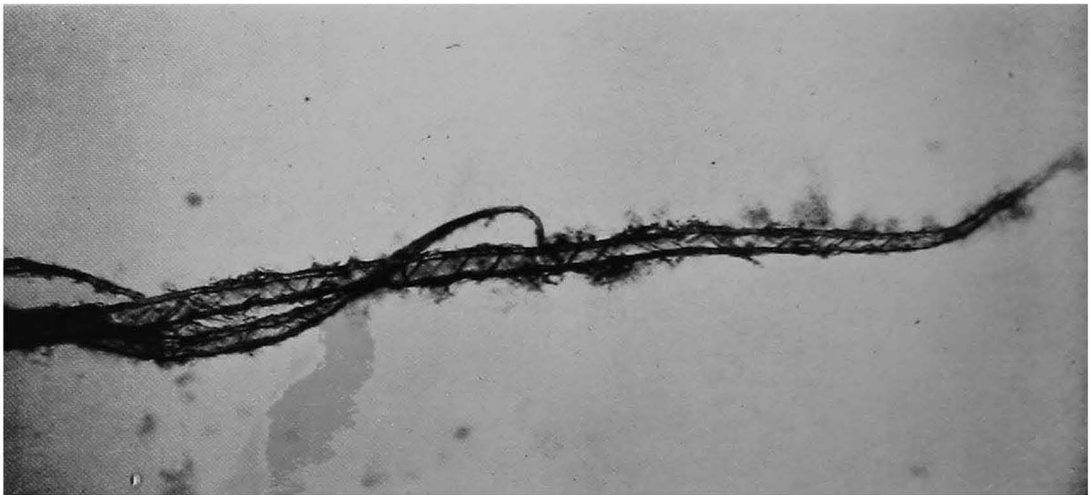


FIG. XII.

Henequen fibre macerated out of the wide lumened bundle swollen in copper oxide/ammonia. Magnified 85 times. (Tobler.)

another way of distinguishing between the fibres derived from the two groups of the vascular bundles. This difference was not so well marked with Java Sisal in which case he observed rotation with fibres of both groups, but it was more marked with the fibres with the wide lumen. He observed that the latter fibre elements were more difficult to isolate by maceration, tending to form groups in many cases of three twisted together. Such groups were very difficult to separate.

Molecular Structure of Sisal Fibre

In a recent paper by H. Mark, it is stated that the use of cellulose compounds to such a large extent in industry is largely due to their unusual mechanical strength. He quotes a table showing that hemp has a tensile strength of roughly 80–92 kilograms per sq. mm. as compared with steel at 50–160, and copper at 20–50, etc., whilst Tchoubar gives the value for Sisal as from 60–75 kilograms per sq. mm.

Thus the strongest of the cellulose fibres are as good or even superior in tensile strength to many metal wires. This remarkable fact has led to the investigation of the mechanical behaviour of cellulose by means of an examination of the relationship between its tensile strength and its structural model. Cellulose, according to Mark, consists of ultimate fibres with a diameter between 1 and 5 deniers and of irregular shape.

These fibres are built up of bundles of long molecular chains, which are held closely together and known as "micelles." The number of such chains per micelle is unknown but one such bundle in native cotton or ramie fibre consists of 40–60 of these chains. The diameter of a micelle is between 50 Å and 70 Å, so that one single fibre contains about ten million micelles in its cross section. The chains themselves are built up of glucose units linked together by consecutive 1–4 glucoside bonds. These are called "main valence chains" and form the backbone of the structure. Their average length is not fixed, but in natural samples of fibres such as those now under discussion, these chains are estimated to contain about 150–200 glucose molecules. Glucose units, main valence chains and micelles are the three essential building stones of cellulose fibres. In a discussion upon "Colloidal structure and its biological Significance" Dorothy Jordan Lloyd traces the various successive phases of cellulose fibre formation and growth and points out that plants make for themselves a protective cover for the protoplasm of their cells. The green

plant has the power of synthesising glucose from water and carbon dioxide under the influence of sunlight. Since water, carbon dioxide and sunlight are generally available together at certain seasons, continual synthesis of glucose presents no difficulty to the plant, and this carbohydrate therefore certainly forms a convenient raw material, not only for cycles of biochemical activity, but also for structures which are the end products of a non-reversible series of chemical changes such as are involved in building up the permanent stable structures in plants, cellulose cell walls, fibres of wood, Sisal or bast, etc., cotton hairs and so on.

Haworth has shown that glucose exists commonly as a six-atom ring configuration (known as the "pyran" ring) which also has a side chain. The glucoses or "pyranoses" have a compact structure with plenty of polar groups available for association with water and for taking part in chemical reaction. As already stated glucose molecules have the capacity for joining up with each other by means of bonds or linkages giving a new class of substances known as "saccharides", thus giving rise first of all to a disaccharide, known as cellobiose.

By repetition of such combinations we get "polysaccharides" or long chains of "pyran" rings, as mentioned above, joined together by glucoside linkages, giving a chain of open structure and finally by telescoping this chain, i.e., by rotating it at the glucoside oxygens, we get a compact chain of the type which evidence suggests is probably found in cellulose. Thus the cellulose carbohydrate chain contains a compact backbone, formed by regularly repeating units, consisting of six-atom rings alternating with other six-atom rings, and giving a definite X-ray picture indicative of a crystalline structure. The chief biological function of such a structure is protective and hence we find it highly resistant to the attack of the ordinary saprophytic organisms present in air and water. Dorothy Jordan Lloyd emphasises the biological function of tissues such as the keratinous layer of the epidermis of animals, cellulose walls in plants, external fibres such as wool and cotton hairs, and internal fibres such as bast fibres or Sisal, is purely mechanical since chemical activity is not desired during plant growth.

Here the importance of the backbone of the colloid is paramount, and hence we find in such tissues as enumerated above, compact stable ring structures which leave little space for the incursion of water or disturbing molecules. In the plant world, these resistant fibres, as already indicated, are carbohydrate.

In stretching a cellulose fibre, Mark has suggested that the micelles, which are originally orientated almost at random in the fibre, gradually become orientated parallel to the direction of stretching. He supposes that the micelles remain intact during stretching and that they flow as if they were soft worm-like bodies. As a result of his observations he proposes an interesting theory regarding tensile strength which leads to the formula :—

$$F = F_0 \frac{v^3}{1 - \rho + \rho v^3}$$

Where v is the extension of the fibre as given by the equation $v = l/l_0$, l_0 being the initial length and l the actual stretched length of the sample, ρ represents the axis ratio of breadth to the length (i.e. $b/l = \rho$) of the geometrical dimensions of the micelles, and F represents the strength of the fibre. For technical application it is of importance to note that the possibility of strengthening a cellulose fibre by extension is a function of ρ , i.e. the ratio between the breadth and length of the micelles. The nearer these two factors are to equality the less is the chance of increasing the strength by stretching as can be done in certain artificial cellulose fibres. Thus in practice only a material which contains *long* bundles gives good and fast fibres.

Van Iterson has shown that the extension curve of non-ductile fibres (such as flax, ramie and hemp) has the form corresponding to the upper curves of the series given by Mark, namely, when the value of ρ is such that $l = 10b$. For ductile fibres, such as coconut and kitul, the value corresponds to $l = 3b$, whilst for Sisal, the value is given as being of the same order.

Ductility

An important characteristic of Agave fibres is their ductility or ability to stretch beyond their elastic limit without rupture. The investigations of Sonntag (Flora 49, 1909, 203) have shown that vegetable fibres may be divided into two classes, ductile and non-ductile. Certain fibres, such as *Cocos nucifera* (coir) and *Agave americana*, when loaded beyond their elastic limit are permanently stretched. Sonntag gives the extensibility of fresh (wet) *Agave americana* fibre as 20-30 per cent., against 6 per cent. for the air dried fibre. According to Sonntag, ductile fibres are invariably highly lignified. A study of the degree of lignification and the ductility of a large number of fibres does not establish any direct relationship,

many highly lignified fibres being non-ductile. His contention is that the property of ductility must be related to the physical structure of the cell wall itself.

Ductility and Physical Structure

Many investigators have noted the striations which appear on the lamellae of the cell walls. These markings usually form a right-hand spiral on the outer or primary membrane and a left-hand spiral on the inner or secondary membrane, and have generally been regarded as indicative of the molecular structure of the cell walls. Tobler, as also Heermann and Herzog have subsequently investigated these spirals in Sisal fibres. Hanberlandt, as early as 1879, regarded these spiral striations as an indication of the arrangement of the micellar chains of molecules. Sonntag has looked for the cause of ductility in the arrangement of these spirals. He isolated the cells by maceration and measured the angles which the striations made with the longitudinal axis of the cell. The angle of the micellar planes is more frequently seen in the secondary membrane by the inclination of the pores which follow the line of cleavage. With the aid of microchemical reagents, Sonntag was able to observe and measure the angles which the striations or pores in each membrane made with the cell axis, his investigations embracing a large number of vegetable fibres. His results for coir, *Agave americana*, and hemp (*Cannabis sativa*), are tabulated below :—

Fibre.	Condition.	Inclination of striations in the		Extensibility of Fibre.
		Primary Membrane.	Secondary Membrane.	
(1) <i>Agave americana</i> ..	Air dry	25°-38°	25°-40°	Up to 5.9%
..	Fresh	25°-38°	25°-40°	.. 20-30%
(2) Coir	Air dry	53°-54°	30°-53°	.. 16.0%
(3) <i>Cannabis sativa</i> ..	..	90°	4°- 8°	.. 1.27%

The comparison of the angles made by the striations of typical ductile fibres (1 and 2) with those of a non-ductile fibre (3) shows that, in the case of the latter fibre, the striations in the outer lamella are nearly perpendicular to the cell axis, whilst those of the inner lamella run more nearly parallel to it.

Examination of ductile fibres by means of polarised light showed that the variations in the polarisation colours followed very closely the variations in the figures for the angles of inclination of the striations, the ductile fibres forming one group. The early discovery of the significance of double refraction of light by cellulose structures, due to Nageli, and its subsequent confirmation by X-ray spectroscopy, is well known. There results from such measurements, therefore, two values of the refractive index for light corresponding to the deviation of the ordinary and extraordinary rays in their passage through the fibre. The difference between these two values from each other is indicative of the micellar structure of the material. Preston has recently pointed out that if regenerated cellulose rays are compared with natural cellulose fibres, then from bi-refringence observations upon the two, it may be concluded that the difference in structure lies in the fact that the former are composed of cellulose which is less orientated than the latter. The lower bi-refringence observed, as indicated by the difference in value between the two refractive indices, should be due, if the above argument is true, to a rise of the lower value and a fall in the higher one. A fall in both is actually what occurs, the higher falling more than the lower, hence rendering the difference between them less in value. That a native cellulose fibre does show a rise in the value of the lower index and a fall of the higher index is seen in the case of cotton, Sisal and certain other fibres, as compared with the values for linen and ramie. Values for the two refractive indices ($n\gamma$ and $n\alpha$) for linen, ramie and cotton, due to Preston, and for *Agave perfoliata* (due to Frey) are quoted below, as also for the angle of orientation calculated therefrom :—

Fibre.	$n\gamma$	$n\alpha$	Bi-refringence.	Angle of Orientation.
Linen and Ramie	1.596	1.528	0.068	—
Cotton	1.578	1.532	0.046	30.0°
<i>Agave perfoliata</i>	1.559	1.536	0.023	46.7°

The fall in the values of the indices is obvious, as also the decrease in bi-refringence. Linen and ramie are known to have a parallel micellar structure, whilst the other two, as indicated above, have a spiral structure. The inference from the above figures, therefore, is self-evident.

Agave fibre cells examined with crossed nicols and a Gypsum plate, Red 1, with the longitudinal axis of the cell being over the greater axis of the plate (that is with both making an angle of 45° with the plane of polarisation), the inner membrane shows up strongly with a deep blue coloration.

From his observations Sonntag draws conclusions as to the factors upon which depend the ductility of fibres. From actual measurement it is seen that the angles of inclination of the striations in the case of the fibres with the greatest ductility show that the striations of the lamellae were always oblique, that is, they were not perpendicular or parallel to the cell axis. Further, the inclination of the right-hand spiral in the primary membrane was, approximately, the same as that of the left-hand spiral in the secondary membrane. An illustrative model will explain the cellular mechanism.

If two spirals of wire are wound round a pencil in right-hand and left-hand directions respectively, and then fastened together the extensibility of the whole unit is limited by that of the spiral with the steepest "pitch" (the shortest piece of wire), which in the limit would break before the other was fully extended. This is the model which Sonntag suggests for the cell walls. When the spirals have approximately the same "pitch", the ductility is at a maximum. The theoretical considerations derive support from the study of the breakage planes of a ductile and a non-ductile fibre. Whereas the former breaks cleanly, the latter gives a very jagged cleavage. Microscopic examination of the broken edge in the latter case reveals that the inner membrane is broken up, whilst the outer is found in the form of long spirals attached to one or other of the pieces of the filament.

Physical Properties

In measuring the tenacity of individual fibres for purposes of comparison, account must necessarily be taken of relative areas of cross-section. This is of particular importance when we take into account the occurrence of the two fibre types previously mentioned. Moreover, values for tenacity are only useful for purposes of comparison when they have all been determined side by side under the same conditions. Widely divergent figures are given for Sisal by different investigators, largely as a consequence of lack of uniformity in testing methods and sampling.

An important technological study of Sisal and Manilla fibre has been carried out recently by Dantzer and Roehrich, and communicated privately. The system of physical measurements which they have adopted is suitable for assessing the commercial value of fibres of different origin, and a description of their methods will enable their data to be more fully understood.

Rigidity

Dantzer and Roehrich classify fibres normally under the headings "hard" and "soft," according to their flexibility or rigidity. The term "hard" is applied chiefly to fibres suitable for the manufacture of cordage, and the value of such a characteristic is expressed by them in terms of a quantity called the *Index of Rigidity*.

In the Empire Marketing Board publication on Sisal No. 10, it is stated that true hemp is a non-lignified fibre, possessing a character which leads to its inclusion in the class of "soft" fibres; the other products are more or less lignified and belong to the category of "hard" fibres. Sisal, henequen, etc., are included in the latter group. S. Tschoubar, (*Revue Textile* September, 1930), suggested a method for the determination of this quantity, which may be briefly described. A bundle of fibres, 15 cm. long, and weighing 0.01 gm., is clamped at one end and suspended from a suitable stand. To the lower end is attached a metallic disc, by means of which torque is applied to the fibres by giving the disc a number of turns. On releasing it the fibres immediately commence to untwist and the disc oscillates for a certain time before finally coming to rest. This period (T) measured in seconds, affords, according to Tschoubar, a measure of the rigidity of the fibres.

In order to furnish a basis for comparison, a standard is adopted in relation to the performance of specially selected viscose filaments (d.300) which, under the above conditions, gave a value for the time taken to come to rest of 15 seconds. The index of rigidity for the standard viscose filament was unity, and if e.g. a fibre gives a value of $T = 6$ seconds, its index of rigidity is calculated as $\frac{15}{6} = 2.50$, which really implies that the fibre is $2\frac{1}{2}$ times more rigid than the viscose standard. Any fibre with an index above 1.80 may be regarded as a hard fibre, nearly all of which are derived from the leaves, etc., of monocotyledons. Sisal and manilla, sansevieria and aloe fibre, all have both a rigidity index greater than two.

Fineness

Dantzer and Roehrich classify the fineness of a fibre as indicated by the "Metric Number" which is defined as the length of the fibre in kilometers, which will weigh 1 kilogram. Ten cm. lengths of the fibre are cut from the middle of the filasse and the weight of 100 is determined.

$$\text{The Metric Number} = \frac{100 nl}{P}$$

where n = the number of fibres.
 l = length of fibres in cm.
 P = wt. of whole in mgm.

Assuming, perhaps somewhat arbitrarily, that a cordage yarn contains a minimum of 35 fibres in its section, the count of the finest possible yarn may be determined from the formula $C = \frac{N}{35}$. Thus, according to Dantzer and Roehrich, Sisal fibre, with 37·300 m. to the kilogram, should yield a yarn measuring slightly more than 1,000 m. to a kilogram.

Tensile Strength

The most important quality of cordage fibres is their resistance to breakage, and this Dantzer and Roehrich have studied in the following manner:—

(a) *Breaking Length*: is defined as the length of fibre in kilometres which, if suspended from one end would break under its own weight. A certain number of fibre lengths of 10 cm. are tested in a testing machine, the jaws of which are placed at a distance of 5 mm. apart. If F is the resistance to breakage in gm. and P is the weight of the fibres taken for the experiment, then the breaking length $L = \frac{1F}{100P}$. For a sample of Sisal, they have calculated that $L = 56·9$ km.

(b) *Tensile Strength per Square Millimetre*.—The tensile strength of a fibre of unit section may be calculated by the formula $R = LS$, where R is the stress in kgm. per sq. mm.,

L the breaking length, and S the specific gravity of the fibre which is assumed to be 1.5 for all cellulose fibres. Thus for Sisal, $R = 56.9 \times 1.5 = 85.3$ kg.

(c) *Apparent Density*.—It is obvious that since the Sisal fibre is not solid its apparent density is the quality most easily measured. In order to have an idea of the tensile strength of the actual fibre substance, Dantzer and Roehrich have determined the apparent density of the fibre, that is to say, its density as determined from its volume without taking cognisance of the correspondence due to the presence of the lumen, hollow spaces and twisting, etc., of the fibre. To determine this, use is made of the following rapid method of Tschoubar.

A micrometer is employed (the jaws of which are modified to hold a bundle of fibres rigidly, the screw reading to one hundredth of a mm.). The force of compression exerted upon the bundles so held is limited to 2 kg. per sq. mm. by the operation of a ratchet. A bunch of fibres of length "l" (in practice 10 cm.) of weight "p" (in practice approximately 0.25 gm.) is placed between the teeth of the lower jaw. The distance between the teeth "e", is in practice about 2 mm. The plate of the opposite jaw is placed in position and the micrometer screwed up until the ratchet functions, the pressure remaining constant. The micrometer reading "h" represents the thickness of the group of fibres under a constant pressure. The apparent density is given by the equation $S' = \frac{p}{e \times hl}$ where p = the weight in gm. of the bundle of fibres.

For example the Sisal cited above $S' = \frac{0.25}{0.2 \times 10 \times 0.152} = 0.823$. Dantzer and Roehrich point out that this method is open to criticism since the measurement of apparent density is influenced by the interstices between the fibres according to their size and shape, but the interest in the measurement lies in the fact that the pressure exercised is of the same order as that applied by the twisting during the manufacture of cordage. The significance of an apparent density of 0.823 where the fibre substance has, it is supposed, a density of 1.5 is that about 55 per cent. of the cross sectional area of the fibre is actually occupied by the solid material.

(d) *Tensile Strength per Square Millimetre of Actual Cross-section.*—The principal application of the apparent density determination is to calculate this new characteristic. It gives a comparison of the fibres on a basis of equal weight. The following formula gives the actual resistance $R' = L \times S'$. In the case of the Sisal already given as an example $R' = 56.9 \times 0.823 = 46.4$ kg. per sq. mm. of actual cross-section.

The following table gives the principal characteristics of the Sisal fibres of various origins which have been studied by the methods indicated above.

Sisal Designation.	Index of Rigidity.	Metric number of the fibre N in metres.	Count of finest yarn possible $N_c = \frac{N}{35}$ in metres.	Breaking length in klm.	Tensile strength in kgms. per sq. mm. of fibre substance.	Apparent Density.	Tensile strength in kgm. per sq. mm. of actual cross-section.
French Sudan . .	2.31	37.300	1.060	56.9	85.3	0.823	46.8
" " ..	2.20	35.800	1.020	63.8	95.7	0.785	50.0
British " East Africa No. 1.	2.14	40.900	1.140	53.7	80.8	0.790	42.4
Java	2.73	27.400	780	48.1	72.1	0.845	40.6
Mexico henequen	2.73	26.600	760	39.3	58.9	0.696	27.3

The apparent density is approximately the same for all the fibres studied, the values being between 0.785 and 0.900, with the exception of Mexican Henequen which was low, namely 0.696. With regard to tensile strength, the Sisal from British East Africa exceeded 80 kg. per sq. mm., which is an excellent figure; Java, and particularly Mexican are less strong, the low value for Mexican Sisal being confirmed by a large number of experiments.

Methods of Distinguishing Sisal from Manilla

Since Sisal fibre is often mixed with Manilla hemp, it is important to have reliable tests which will enable the two fibres to be distinguished from each other.

Dantzer and Roehrich (loc. cit.) have dealt with this subject in detail. Three methods are given by which the presence of an admixture of Sisal fibres in a Manilla rope may be ascertained.

1. *Microscopic Examination of Fibre Sections.*—As has already been mentioned, a section of a Sisal fibre shows in most cases a characteristic horse shoe or crescent shape, Manilla, on the other hand, yields sections which are approximately circular in form. An approximate estimation of the percentage of the two fibres in a mixture may be achieved by cutting sections of equal thickness from a large number of the mixed fibres, dividing them according to their contour into two groups which are then weighed. Since the apparent density of the two fibres is of the same order, their percentage can be calculated. It is not suggested as anything but a very approximate method.

2. *Comparison of Elementary Fibres.*—An examination of the sections of elementary fibre cells reveals certain differences between the two fibres but since the different grades of both the fibres show in themselves a great deal of variation it is not possible to define any distinguishing test which can be applied with certainty. The two fibres Sisal and Manilla are often almost equally lignified so that it is hardly possible to distinguish them by means of the usual micro chemical reagents. By boiling the small pieces of both types of fibres with alkali the elementary fibres are separated and whilst there is not much difference in the appearance of ultimate fibrillae and Manilla and Sisal may be distinguished by measurements of their length. The elementary fibres of Sisal are from 2 to 3 mm. in length, whereas those of Manilla may be as long as 10 mm. but are on the average 4 to 6 mm.

3. *Microscopic Examination of the Ash.*—When threads or bundles of the two fibres were ignited and the respective ashes examined, the following differences were noticed.

The ash of Manilla is grey in colour and that of Sisal is whiter. A certain amount of experience is necessary in order to be able to differentiate between the two by colour alone. Immersed in alcohol and examined under the microscope the two ashes reveal distinguishing characteristics. The ash of Manilla is characterised by chains of silicious skeletons of the "Stegmata" cells. The ash of Sisal contains thick blackish needles pointed at both ends occurring sometimes

singly and sometimes in dual form. These needle-like forms consist of calcium carbonate which has been produced by calcination of the calcium oxalate present in the fibre.

4. *Examination by Ultra-Violet Radiation.*—For this purpose the fibres were irradiated by ultra-violet radiation from a recognised analytical lamp. The filasse of Sisal showed a somewhat insignificant fluorescence of a yellowish or bluish colour, Manilla gave a very strong fluorescence from blue to violet in colour, described as “Parma” violet in shade. Manilla of inferior quality with a strong brown coloration responds to the test plainly. Thus in a mixture of the two fibres in a yarn, by spreading out the fibres brush like and examining them individually for fluorescence, an estimate of the percentage of Sisal or Manilla may be effected, the fluorescent and the non-fluorescent fibres being weighed separately.

In this connection, Dantzer and Roehrich mention a recent observation of Kraus. Bundles of Manilla and Sisal fibres were separately exposed to the sun for 16 hours, half of each being masked from the sun's rays. The protected portions gave a bluish tint with Sisal, but a strong violet fluorescence in the case of Manilla. The exposed portions remained yellow in the case of Sisal and blue with Manilla, the blue of the latter being only slightly more intense than that of the unexposed Sisal.

A chemical method of distinguishing between the two fibres is described by C. E. Suett, (*Industrial and Engineering Chemistry*, 1918, **10**, 227), who states that on treating Manilla with bleaching powder and acetic acid, followed by ammonia, it is coloured brown. Sisal and other hard fibres give on similar treatment, a cherry red coloration.

Identification of Sisal by Means of Neocarmin W.

A further method of identification of textile fibres has been furnished by Neocarmin W. If a distinction is wanted between Jute, Coconut and Sisal, it is simply done by carrying out the following procedure:—

1st Method.—The fibres are immersed in Neocarmin for about 5–8 minutes. The sample is then rinsed in running water, passed through water containing a little ammonia and again washed. The following distinctive colorations are then obtained:—

Jute .. .. .	.. .. .	Olive brown.
Coconut fibre	.. .. .	Brown.
Coconut yarn	.. .. .	Olive.
Sisal .. .. .	.. .. .	Green.

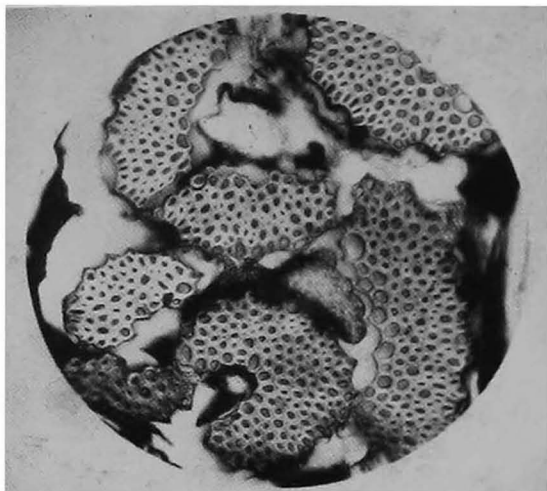


FIG. XIII.
East African Sisal, Unbrushed.
Section magnified 85 times.
(Tobler.)

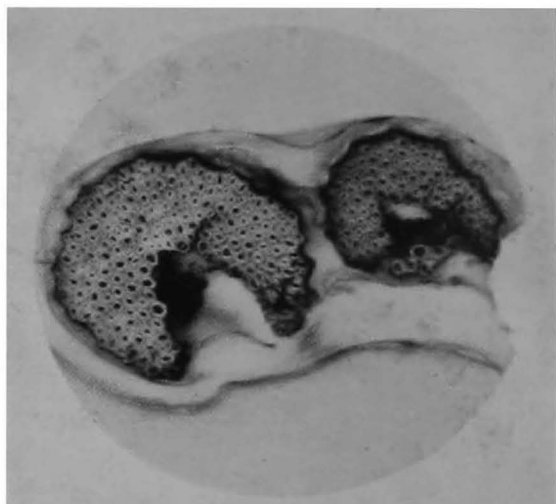


FIG. XIV.
East African Sisal.
Section magnified 85 times.
(Tobler.)

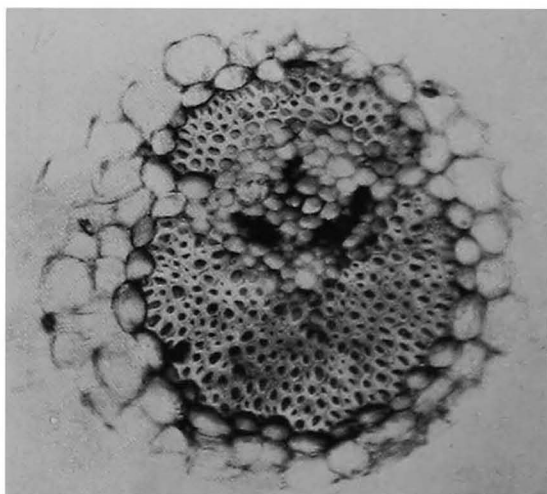


FIG. XV.
Section through a single vascular
bundle out of a leaf of *Agave four-*
croydes (Henequen).
Magnified 85 times.
(Tobler.)

2nd Method.—The sample is dipped in Neocarmin which has been heated to boiling point. It is then rinsed in running water, immersed for about 10 seconds in water containing a little ammonia and finally again washed. This method produces the following very distinctive colorations :—

Coconut fibre	..	..	Brown.
Coconut yarn	..	..	Olive.
Sisal ..	..	..	Blue.

The second is perhaps the better method.

The Commercial Applications of Sisal and its By-Products

The Fibre.—The inherent structure of the Sisal fibre has largely defined its sphere and range of commercial utility in the past, and unless research is actively promoted in order to find methods of treatment to render it suitable for other uses, i.e. amenable to new types of processing, it is likely that its use will still be restricted to cordage, ropes, twine, etc., for which many other fibres are also highly suitable. It has found a large sphere of utility for cordage and has also been woven into coarse canvas for hessian types of fabrics, either alone or in association with other fibres such as hemp, flax or cotton.

Properties.—Sisal is a relatively white fibre, having a pleasing appearance. The uniformity of length, quality and appearance with which it can be marketed makes it eminently suitable for the production of binder twine, cords, and fine yarns up to 2 lea.

(1 lea yarn is one of which 900 ft. weigh 1 lb.)

(2 lea yarn is one of which 1,800 ft. weigh 1 lb.)

The report of the Imperial Economic Committee on hemp fibres (1932) calls attention to the fact that Sisal found a large outlet in the manufacture of "binder twine" for use with the "self-binder" harvesting machine for grain crops. Wigglesworth has shown that each acre of grain crop harvested would require a ball of Sisal twine weighing 4 lb., and when one considers the enormous world acreage under wheat this was a very great requirement. The Imperial Economic Committee's report, however, goes on to note that the self-binding machine is now being rapidly replaced by the combined "harvester thresher", which cuts and threshes the crop in one operation as the machine is propelled round the field, so that no binder twine is needed.

In the Imperial Economic Committee's report on the "Wheat Situation in 1931", they call attention to the rapid increase in the use of this combined machine and state that in Kansas the acreage cut with self-binders is now negligible. In Western Canada "combine harvesting" is now the accepted method; in Australia the combined harvester thresher is now "universally used"; in the Argentine over one-third of the crop is thus harvested; in Russia its use is spreading, whilst the Ministry of Agriculture Bulletin (1929) considers that small machines of this type have a great future in this country. Statistics are quoted in support of the contention of the decline of the use of Sisal binder twine, and the Imperial Economic Committee "envisage a narrowing market for binder twine and the absorption of the supply of Sisal must depend upon its extended use for commercial twines, ropes and other purposes". In other words, new uses for the commodity must be found, just as in harvesting the progress of science has evolved a new machine rendering the more laborious methods obsolete, so with Sisal, new uses founded on the requirements of modern industry and present-day human demands must be found, preferably outside the range of uses for which other fibres are perhaps equally suited.

Marine Cordage.—For marine cordage there has seemingly been a general impression that Sisal ropes deteriorate more rapidly than Manilla Hemp under the action of sea water; that they swell rapidly and lose buoyancy, and finally that they fail to recover their original girth when subsequently dried. Investigations at the Imperial Institute have been specially directed to the proof or otherwise of these contentions. The Empire Marketing Board Publication No. 10 records that the German Fleet was equipped with Sisal cordage during the War. The Imperial Institute experiments are fully recorded in their various Bulletins. Parallel tests were carried out upon ropes made to standard specification from commercial grades of Sisal and Manilla (i.e. first and second quality East African Sisal and several grades of Manilla Hemp). The periods of immersion in sea water under identical conditions were four, six, nine and twelve months, and records of deterioration were taken at these periods.

Tendering of Sisal Ropes by Marine Influences.—"Wet tests" consisted of exposure of the Sisal and Manilla ropes to tidal immersion and subsequent inter-tidal draining so that each tide the rope was

submerged for a period and uncovered for a period. "Wet and Dry tests" were conducted by removal of the ropes from the box in which they were enclosed for immersion purposes, periodically, and placing them in a dry situation (usually for two months) before re-immersion. In both series of tests portions of the ropes were removed at intervals of two or three months, washed in fresh water, and after drying, were re-tested to ascertain the decrease in their tension strength. The results showed that Sisal ropes do not differ widely from Manilla ropes in their resistance to the tendering action of marine influences.

The Sisal ropes appear to be slightly more quickly affected in the initial stages of submergence, but on continued treatment, the results indicate that Sisal is not inferior to Manilla in its powers of resistance to sea-water, and under similar conditions the rate of deterioration of Sisal and Manilla is approximately the same.

Changes in Girth after Immersion in Water and subsequent Drying

It has been stated as an objection that Sisal absorbs water more rapidly than Manilla, leading to swelling which prevents smooth running of the ropes through the pulley blocks.

The Imperial Institute has also investigated this contention and the results show that Sisal absorbs water at approximately twice the rate of Manilla in its initial stages of immersion. Thereafter, Manilla continues to absorb water at a greater rate than the Sisal, so that after a protracted period of immersion, the Manilla has absorbed as much if not more water than the Sisal rope. The rate of increase in girth is slightly more for the Sisal rope than for the Manilla in the early stages, but the difference is not very marked, so that after a period of two hours, the two kinds of rope showed little difference. On drying the rate of shrinkage was approximately the same for both Sisal and Manilla, and on the average of the whole of the experiments, the results indicated that the Sisal rope more nearly retrieved its original girth than the one made of Manilla. Full tabular details are given in the Imperial Institute reports.

Admiralty Tests on Sisal Cordage

In Vol. XXXI, No. 1, 1933, of the Bulletin of the Imperial Institute, a report of trials carried out by the Admiralty on cordage manufacture from Manilla and Sisal hemp is recorded. In order to submit the question of the possible uses of Sisal for marine cordage to practical

trial, the Admiralty manufactured about 50 tons of hawser-laid cordage and issued it to the Royal Dockyards and to H.M. ships. The behaviour of the ropes was carefully observed and duly recorded and it will be seen that the results are regarded as sufficiently promising to warrant the partial adoption of Sisal by the Royal Navy. Arrangements are being made for 50 per cent. of the Service requirements for towing hawsers and for heaving and hauling lines to be made from Sisal, and for its entire adoption in the manufacture of cordage for certain other purposes. In their Report, however, the Admiralty call the attention of users to the main points which are detrimental to its universal adoption.

The Report states :—

“ The following defects can, however, be definitely regarded as peculiar to marine cordage from Sisal.

1. Shrinks in length when wet and requires tending continually in wet weather.

2. Swells when wet, although, except in two or three isolated cases, it was insufficient to interfere with its working through blocks.

3. Elongates considerably under load, particularly when wet, and in some cases becomes definitely long jawed. Under some conditions it tends to return to size after load is removed, but generally the extension is more or less permanent.

4. Becomes greasy and slippery, is difficult to handle when wet, and greater care is necessary when working it round a cleat or bollard.

5. After prolonged use it tends to chafe and fray and becomes discoloured.”

These defects are, however, not insurmountable and probably when proper softening of the fibre is possible, such as e.g. the Hayes-Gratze process, combined with an adequate method of water-proofing such as, e.g. that now suggested by Wilkinson, there is no reason why these defects should not be eliminated. It is purely a matter for systematic scientific investigation and research.

Swelling of Sisal

One point, however, was brought out from this series of tests, namely that Sisal rope when immersed in water appears to lose

buoyancy and sinks more rapidly, due to its more rapid initial swelling and water absorption. Here is an opportunity for research to find a suitable cheap waterproofing medium which will not affect the other characteristics of the fibre.

Impregnations with phenol resins, cellulose, rubber and other materials have been tried, but it is possible that the search for suitable waterproofing material and technique may prove difficult since three factors have to be observed, namely, the material used must be cheap and its method of application simple and not costly, and the impregnating medium must not deteriorate any of the major good qualities of the rope. One large rope-making firm has already made considerable progress towards the solution of this problem of the production of a non-swelling and waterproofed material, but further research still remains to be done.

It is true that waterproofing of other textiles is extensively practised, but it is doubtful if any of the methods generally employed could be utilised on the ground of expense, for after all what is being attempted is to render the fibre more suitable for certain purposes for which other materials are now being successfully used without such treatment, and the question becomes one of economics.

In addition to the results put forward by the Imperial Institute, it is of interest to record figures furnished by W. H. Wilkinson, for the swelling, buoyancy and water absorption of parallel ropes of Sisal and Manilla during short periods of immersion in fresh water. Tests were carried out upon the water absorbed by three inches circumference Manilla and Sisal ropes, whilst immersed for short periods in fresh water. These ropes were in the condition that they would go into use, containing the oils, etc., added during spinning. In order to remove the influence of the spinning oils, etc., tests have also been made upon specimens, from which the oils have been extracted. These tests give a true indication of the water absorbing properties of the fibre without any extraneous disturbing influences. The readings recorded were taken at half-hour intervals up to five hours, and then once more after immersion for twenty-four hours. All the samples were two inches long, whipped at the ends but not sealed in any way. A duplicate series of each test was made. The table on page 42 gives the actual results.

Water absorbed by 3 in. circumference Manilla and Sisal Ropes during Short Periods of Immersion in Fresh Water. (Wilkinson.)

Time of Immersion in Hours.	Water absorbed as percentage of original weight.					
	Sisal.	Sisal. Oil Extracted.	Manilla. High Grade.	Manilla. High Grade Oil Extracted.	Manilla. Low Grade.	Manilla. Low Grade Oil Extracted.
½ ..	33.05	48.33	6.45	17.70	5.84	8.99
1 ..	36.00	48.57	8.59	22.22	7.87	11.51
1½ ..	36.98	48.66	9.55	24.65	9.23	13.27
2 ..	37.66	48.92	10.49	26.57	10.16	14.53
2½ ..	38.02	49.34	11.16	28.15	10.82	15.53
3 ..	38.18	49.37	11.84	29.20	11.54	16.70
3½ ..	38.41	49.42	12.44	30.48	12.02	17.22
4 ..	38.55	49.43	13.19	31.27	12.73	18.01
4½ ..	38.86	49.45	13.78	32.25	13.50	18.61
5 ..	39.32	49.46	14.24	33.54	14.07	19.59
24 ..	41.66	52.03	18.43	42.67	22.43	29.77

Time required for Sample to Sink

Sisal.	Sisal. Oil Extracted.	Manilla. High Grade.	Manilla. High Grade Oil Extracted.	Manilla. Low Grade.	Manilla. Low Grade Oil Extracted.
12½ mins.	3½ mins.	1½ hrs.	1½ hrs.	2¼ hrs.	2hrs. 35 mins.

Percentage Increase in Circumference due to Swelling in 24 hours

Sisal.	Sisal. Oil Extracted.	Manilla. High Grade.	Manilla. High Grade Oil Extracted.	Manilla. Low Grade.	Manilla. Low Grade Oil Extracted.
5.77	7.69	4.08	5.10	4.00	6.12

The tests rather seem to indicate that Manilla ropes absorb approximately the same amount of water but at a slower rate. In other words, the total amount of water ultimately absorbed by Manilla is approximately similar to that which Sisal will absorb, but the absorption curve of the latter is much steeper. The natural consequence is obvious, namely since ropes are usually only immersed in water for short periods, the practical performance of the two fibres is rather marked. In the application of various manufacturing treatments to Sisal and Manilla, Wilkinson records that the steep absorption curve of the former renders it somewhat more responsive than Manilla, a factor of significance in rendering it waterproof as also in finding new uses for it.

Specially Prepared (Waterproofed) Sisal Rope
Water absorbed as percentage of original weight
(One series of tests only in each case)

Time of Immersion in Hours.	Treatment No. 1. Colour Green.	Treatment No. 2. Colour Green.	Treatment No. 3. Colour White.	Treatment No. 4. Colour White.
$\frac{1}{2}$	1.20	1.25	2.20	3.47
1	2.00	2.35	3.17	7.02
$1\frac{1}{2}$	2.04	3.01	4.00	8.13
2	2.34	3.28	4.72	9.67
$2\frac{1}{2}$	2.75	3.67	5.25	11.95
3	3.46	4.22	5.81	12.92
$3\frac{1}{2}$	3.54	4.43	6.27	14.61
4	3.56	4.73	6.71	15.67
$4\frac{1}{2}$	3.85	4.93	7.15	17.35
5	4.18	5.33	7.56	18.68
24	6.85	9.69	14.58	29.35
Time required for sample to sink.	Not sunk in 24 hrs.	5 hrs.	24 hrs.	$4\frac{1}{2}$ hrs.
Percentage increase in circumference due to swelling in 24 hours.	Nil.	Nil.	3.92	6.00

W. H. Wilkinson reports that he has conducted experiments in connection with Messrs. British Ropes, Ltd., on the preparation of a waterproofed Sisal rope. The foregoing table gives the results

of tests carried out by him on this material, from which it is seen that the results indicate not only a considerable decrease in water absorption properties, but also an increase in buoyancy without corresponding increase in girth or bulk. He further reports that trials on ropes of this character, under actual service conditions, have shown such treatment to be satisfactory and lasting.

Swelling of Sisal in Cuprammonium Solution

A description of the peculiar swellings given when Sisal fibre elements are treated with copper oxide/ammonia solution, is given by Ludtke (*Faserforschung* 10, 1932, Pt. 1). The appearance of the fibre is like a row of pearls. The primary membrane sheath and the inner membrane sheaths are left unaffected and can be observed. The striations are also visible. The investigation showed conclusively with Sisal and other fibres that the primary membrane had a separate existence from the middle lamella, a matter that had always been in some doubt.

Softening of Sisal

It has long been suggested that if Sisal could be satisfactorily softened there would open out for it a variety of new uses along paths which are at present closed on account of its hardness. A number of processes with this object in view have been proposed and may roughly be divided into three classes :

- (1) Chemical processes.
- (2) Impregnation processes.
- (3) Mechanical processes. These are applied by splitting the fibre first into strands by special combing machinery and are to-day most important as being in actual use.

Chemical Processes

Having regard to the structure of fibre, which depends for its strength upon the adhesion of groups of very short elementary fibres, which seemingly overlap each other, it is difficult to realise how any of the chemical processes yet suggested, can be effective without materially decreasing the tensile strength of the fibre. On the other hand, uses might be found for softened fibre where decreased strength might not be detrimental, but in textiles this is difficult to visualise.

Many of the chemical processes described have aimed at the elimination of decorticating machinery altogether, with the substitution of a type of retting, in the endeavour to achieve simultaneously

the separation of the fibre from the flesh of the leaf and also to accomplish a degree of softening. In most of these processes the leaves are retted and then heated, sometimes under pressure, with dilute solutions of alkalis or weak acids. The efficiency of decortiating machinery has been so increased that it is difficult to realise how any process which involves chemical treatment of a large weight of leaf to produce a comparatively small weight (about 3 per cent.) of fibre can be economic unless the cost of the chemicals is very low and the process exceedingly simple, as e.g. merely steeping in open tanks. On the other hand this possibility must not be lightly dismissed for it may be that a chemical method of treatment can be found which leaves the 97 per cent. of megasse in such a condition as to be of economic value, as forming a raw material for a new use in modern industry. Secondly, it must also be remembered that the fibre might also be rendered into such a condition that it would demand a higher price on the market.

Research on this point is well worth while, but the problem must be considered not merely as one of Sisal extraction alone, but the utilisation of the leaf as a whole. Of recent processes of this character that of Richter and Schmidt, which has been so widely discussed in Germany may be briefly reviewed. It is set out in German Patents (D.R.P.) 29a. No. 461,453 and No. 490,293, but a full description of the entire process is given by Richter, in *Faserforschung* Vol. 9, Part 1, 1931.

The Richter and Schmidt softening process

The object of the process is initially to loosen the fibres and then to bring splitting about deliberately, in order that raw material may be furnished for the spinning of finer yarns. The fibres are loosened and softened by treatment in chemical baths and are then combed whilst still wet.

It is suggested that the loosening and softening can be accomplished by immersion in the following baths :—

- (1) A soaking bath of hot or cold water.
- (2) A retting bath as with flax at ordinary temperature.
- (3) A soap bath with or without the addition of oil, e.g. 1·5 per cent. soap or 1 per cent. soap and either castor or cotton-seed oil.
- (4) An alkaline bath of either soda or potash or 1 per cent. ammonia.

(5) An acid bath consisting of 0·1 per cent. sulphuric, hydrochloric or nitric acid, followed by complete washing.

(6) A salt and acid bath consisting of 0·1 per cent. potassium permanganate and hydrochloric acid, or alternatively of potassium chlorate and nitric acid, followed by complete washing out.

Whilst still wet the fibre is combed and submitted to high pressure between rollers after drying. The claims made for the ensuing product are that it is light in colour, highly flexible and capable of being spun to a metric count of twelve. Richter explains the increased flexibility by suggesting that the process removes the ground tissue cells rich in starch with which the fibres are associated. He points out that the elementary fibres obtained by this method give a weak lignin reaction with phloroglucin HCl , which indicates, according to his claim, that a degree of delignification has been accomplished. Figures are not quoted for yield of fibre, tensile strength or behaviour in spinning and other manipulation into finished yarn. A large number of other patents are available claiming to accomplish similar results, but it is significant that they have not yet become an accomplished commercial proposition. A list of such patents is appended at the end of this treatise.

Impregnation Processes

Impregnation materials fall under various headings, and modern science has placed and is still placing before us a plethora of new products for this purpose. It is essential therefore, that each and every one of them be examined in connection with the problem before us. The recent announcement of the production of a creaseless cotton by precipitation of a synthetic formaldehyde urea condensation product inside the fibre under standard conditions, encourages one to ask if such resins or other resins such as the phenol group obtained from low temperature carbonisation experiments cannot be utilised, not only for softening but also for waterproofing of Sisal, and if so what would be the method and technique employed.

In the realm of finer textiles such as wool, cotton, silk and linen, the introduction of wetting-out agents has greatly facilitated wet processing such as dyeing, milling, scouring, etc. A main group of these products consists of sulphonated oils, and again one is tempted to ask if softening cannot be achieved by impregnation of the Sisal fibre with such materials. Modern science is presenting us with a

wide range of such products as are mentioned above and systematic research should be conducted upon their use in order to assess their value for the purposes in view, regarding not only Sisal but hard fibres in general. We will, therefore, review the present situation with regard to this matter.

Resin Impregnation

At the present time any discussion of resin impregnation can only be suggestive since there is at present so little work done upon the subject as regards Sisal that definite facts are few. Attempts to use synthetic phenol resins for waterproofing proved insufficient. Possibly the reason lay in the method of application as also the type of resin used. In the manufacture of creaseless cotton the process is essentially one where the resin must not be without the individual fibres, as in the case of sizing, since a sizing effect would tend to make the material stiff. The synthetic resin must therefore penetrate into the pores of the fibre if elasticity and softness is to be attained. This is accomplished in two ways, either by applying the resin in the form of solution or, better still, actually forming it within the fibre itself. A wide range of synthetic resins may be made by condensing formaldehyde with various organic substances, such as phenol, glycerine, urea, etc., mainly, although not necessarily, those containing hydroxyl groups. Such resins are generally produced by heating together the formaldehyde and the other component in the presence of a suitable catalyst until a water-insoluble resinous product is obtained. The reaction takes place in stages, in the earlier stage of which the product may be water-soluble, hence if the resin is to be applied, rather than formed within the fibre, its first stage must be carried out in so far as it remains soluble, and the final stages must render it into the insoluble form. The British patent for rendering cotton creaseless is the property of Messrs. Tootal, Broadhurst, Lee & Co., Ltd., and details are embodied in E.P. No. 291,473, E.P. No. 291, 474 and E.P. No. 304,900. Typical examples are quoted in the specifications of procedure for formation of a resin, as also application of a preformed resin, within the fibre.

Generally it should be noted that the substances used in the formation of a synthetic resin within the fibre are inexpensive, hence the process should be reasonably cheap. The point at issue for the present work is that all cellulosic fibres are capable of being given an uncrushable finish, and the method can be successfully applied to linen,

jute, hemp and Sisal, etc. Here, therefore, is a method of exploitation of Sisal which is well worth following, and upon which research would undoubtedly be worth while.

Reinforcement of Plastics

In this connection, however, one would mention a new use for Sisal, particularly the short fibres, which has recently been developed. Short Sisal fibre is mixed with a thermo-hardening resin, dried, ground and then moulded by heat and pressure. Fibres of length from one-eighth of an inch to half an inch in length are suitable. A typical example is quoted in the specification for E.P. No. 377,979, taken out by Messrs. Imperial Chemical Industries, Ltd. Seven hundred parts of phenol formaldehyde resole, 600 parts of chopped Sisal, 227 parts of hexamine solution, 53 parts of methylated spirits, 24 parts of aluminium stearate and 28 parts of nigrosine are mixed, dried at 60° C. and ground. The mixture is moulded at 340° C. for 4 minutes at 2,000 lb. per sq. in. pressure. Manilla may also be treated similarly. This yields a plastic composition suitable for moulding into a variety of useful articles.

Preparation of Moulded Compositions for Domestic and other Utilisation

The Bakelite corporation has recently taken out a patent for this type of material which covers the preparation of a mouldable composition suitable for the pressing of large articles, and which comprises loose fibrous material containing fibres of sufficient length to overlap in the composition and also of sufficient stiffness in relation to the length and nature of the fibre to prevent knotting and tangling during the process of mixing, together with a resinic binding agent such as e.g. a phenolic resinoid, i.e. a synthetic phenol resin. It has been found that soft fibres such as cotton, unless ground up very finely are unsuitable as they tangle during the process of mixing so that the resultant mix is not homogeneous. Sisal is particularly applicable. The limit of stiffness required is defined by the fact that when the fibre is stirred in a solution it will not form a loop small enough to grip and entangle another fibre. Fibres cut to lengths of one to one-and-a-half inches are mixed with the resinous material of suitable viscosity, and the solvent evaporated off. The article required is then moulded under a pressure of 1,000 to 3,000 lb. at a temperature of 150° to 175° C. The mix is then left in the press for 15 to 25 minutes to produce the requisite polymerisation. An admixture of 50 per cent.

of Sisal fibre may be used and yields a material which moulds well and produces an article with a good smooth surface, the individual fibres remaining separated. The resistance to shock of the finished article is remarkably good, being ten times that of the ordinary wood flour article. For further details, E.P. No. 353,070 may be consulted.

Such an achievement is indicative of the trend of modern scientific research in relation to raw materials like Sisal. Here is a new use which could not have been previously known since the plastic compositions from the synthetic resins are only just in the initial stages of commercial development, and will undoubtedly go further. Then again, the uses of Sisal for plastic compositions and mouldings for cement and plaster may be developed, if it can be obtained in suitable form and price.

In a private report Messrs. Bakelite, Ltd., stated that the excellent outstanding shock-resisting properties of moulding materials containing Sisal as filler are somewhat minimised by one or two points which have not yet been entirely overcome. Moulding materials containing Sisal as filler have high powers of water absorption and when used under very high humidity conditions, the surface of the material may become somewhat roughened or pitted. Further, the appearance of the moulded article is such when finished, that the coarse appearance of the Sisal ordinarily supplied, cannot be completely masked, and the characteristic shape of the fibre is often discernible.

These difficulties are at the moment standing in the way of the fuller use of the Sisal fibre with its outstanding shock-resisting properties when mixed in such plastics. It is suggested, however, that the waterproofing method of Wilkinson combined with the ionised oil softening treatment of Hayes-Gratze would possibly solve this difficulty and experiments are being conducted to see how far this can be accomplished.

It is obvious, therefore, that in research work on new uses for Sisal, the question of adequate waterproofing and proper softening are the paramount factors for initial investigation.

Impregnation by Oils, etc.

The fact that in France a factory is now actively engaged in spinning and weaving Sisal fibre softened by treatment with a naphthalene sulphonic acid, is sufficient encouragement to discuss the aspects of this type of softening at some length.

The Thuan Method for Softening Sisal

The French process for degumming and softening Sisal and other fibres has been patented by Thuan. (E.P. 354,879.) It is claimed that the action of solutions of simple non-substituted naphthalene sulphonic acids degums and softens vegetable fibres.

The crude fibres after a preliminary soaking are subjected to the action of a bath of the naphthalene sulphonic acid and common salt in equal parts, the strength of the bath being 4° Baumé. After 12 hours treatment in the cold, the fibres are washed in running water and neutralised with a weak soap solution containing a little soda ash. The process may be carried out at 60° C. when the strength of the bath may be reduced to one degree Baumé. It is claimed that this process removes pectins and other gums from the fibres, rendering them more supple. This process is actually being worked commercially.

In this country, research on this point has been directed upon the use of ionised sulphonated oils rather than the ordinary type.

Use of Ionised Oils

Some years ago the question arose as to the effect of passing a high tension electrical discharge through oils in order to render them suitable for medical purposes, with the result that a process was discovered, which is now patented, whereby specially prepared and sulphonated oils were electrically rendered water-miscible, free from oxidation, and bactericidal to a large extent. Their detergent and bleaching characteristics were readily developed, for use in the wool industries, as a fibre lubricant, etc., wherein they produce a bleaching effect and the oil utilised is easily removed by immersion and digestion for a short time in warm water. These oils have more recently been tried as batching oils and as softening agencies for fibres of vegetable origin. Two aspects of the problem are presented, namely:—

- (1) Extraction of the fibre from the leaf and simultaneous softening.
- (2) Softening fibres decorticated by the ordinary method.

Whilst in the latter case direct evidence has accrued as to the efficacy of the method, in the former case only small experiments have been performed and the process awaits further study and development.

Nevertheless, it is a subject of a patent specification which has been granted E. V. Hayes-Gratze. The two points will be dealt with briefly as below :—

(1) *Extraction of the Fibre and Softening at the same time.*—With the ionised oil process the leaves are first treated in a machine or crusher which removes or breaks open the tough outer skin. The leaves are then immersed in a solution of ionised oil (if necessary also ozonised) at a temperature under the boiling point, for a period of from one to two hours according to the amount of softening or splitting-up desired. During this process the leaves are passed in the solution under light rollers which exclude the bulk of the fleshy matter and pulp, without injuring the fibres or causing undue loss of the finer filaments. After another immersion, the remaining fleshy matter is easily removed, and the fibre may be dried. Many claims are made for the efficiency and advantages of the process which on a small scale have been largely justified, but bulk tests still remain to be accomplished. Steps towards this end are being taken. The fibre, as obtained by this method on the small scale, is white and soft, and apparently there is little or no adhesion of groups of two or three together. Bleaching in any form is unnecessary as the fibre is perfectly white, any colouring matter present being bleached by the action of the oil.

If the fibre is passed through yet another bath of ionised oil and water solution, the fibres may be still further acted upon so that additional splitting and softening occur to such an extent as to render them capable of weaving and spinning into finer fabrics and yarns. The claim is made that the tensile strength is not materially affected. The development of the process should be carefully watched.

(2) *Softening Decorticated Fibres.*—Most plantations are already equipped with up-to-date decortivating machinery and in many cases it would be impossible to instal fresh plant or methods, even if such were desirable, for economic reasons. The fibre ordinarily obtained can be subjected to a softening process with ionised oil. The apparatus necessary for this operation is simple and embodies a long tank containing oil solution through which hanks or layers of extracted fibre are continually passing, and wherein they are subjected to mechanical treatment which ensures the action of alternate compressions and absorptions.

The colour of the fibre is improved and the fibre softened. Briefly, the effect is realised by first passing the fibres through a rolling machine, immersing them in a solution of ionised oil in water for the period and at the temperature requisite for the degree of softening desired, rolling or squeezing once more to exclude the excess oil, and then drying and brushing, etc., as in the ordinary process. This process has been tried on a semi-bulk basis with considerable success and further bulk trials are now in progress.

From the foregoing discussion it is evident that if Sisal can be softened then it will probably be accomplished along the lines indicated, namely by taking advantage of its natural absorbent properties, and impregnating the fibre either with resin specially treated with oil or some other material. To assure the future of the producing industry, research in these directions, in the light of the recent discoveries of modern science, is an absolute essential.

Other Uses of Sisal

In the countries of origin the fibre naturally is made to serve a variety of domestic uses, and some of these are of interest, even though they absorb only small quantities. In Mexico the fibre is used for the manufacture of coarse canvas, sacks, mats, hats, harness, hammocks, blinds and brushes. In the United States it is used in conjunction with cotton for the manufacture of coarse canvas, for sacks and for binding twine. In the West Indies a coarse cloth is made from it, which is subsequently steeped in warm water for 24 hours and then left for some time in cold water in order to soften it. In Columbia, a local industry of sack manufacture has grown up amongst the native population. During the war in 1918, it is recorded that the town of Bucaramanga exported over one million sacks and another place exported over two hundred thousand, which meant in actual weight a consumption of 1,200 tons of fibre. In Madagascar the use of Sisal for the manufacture of hats has been of common occurrence for some time.

In Europe, and also in Japan, Sisal has been largely used for the manufacture of braids used in the manufacture of ladies' hats. In Europe these fine braids are knitted by machine. Small factories for this purpose have sprung up in Japan due to the encouragement and activities of the Home Industrial Association of Japan, and the braids so made are shipped to all parts of the world. Tobler records

the use of Sisal for the manufacture of shoe tops, whilst use of it has been made in Europe for the backing of artificial leather made from cellulose spread materials. The fibre has also been used for rubber reinforcement as also for a backing for rubber proofed fabrics and artificial leather from rubber.

A recent patent application in this country describes a method for the manufacture of hat braids and the like, by passing the unwoven strands of Sisal fibre through a solution which cements them together to form a flat strip or straw plait, which can easily be handled by existing machine for hat manufacture, whilst retaining considerable fibre length and lustre. The commercial development of this patent yet remains to be done.

The well-known swelling properties of Sisal have already been discussed, but it has been found that they can be utilised in another direction. It has been found possible not only to swell the fibre but also to enlarge it permanently by impregnation with suitable materials, such as ionised oil. The fibres are rendered soft and flexible by the process and when prepared in this manner, they lose much of their turgoid property and do not swell greatly to a further extent when subsequently immersed in water. The impregnation is accomplished by an oscillatory compression and rarefaction action. Tests recently performed upon cables and fibres of "expanded" and ordinary Sisal of the same type and size, as regards strength, showed that the mean tensile strength of 100 individual fibres taken at random from the cable after unravelling, was 15 per cent. greater in the case of the treated fibre than the normal. It is suggested that such "expanded" or swollen fibre might be waterproofed and thus prove of considerable help in improving its buoyancy. This is a matter for further investigation, but the process is the subject of patent application, and its commercial value and possibility has yet to be demonstrated, for, as already stated, each time the material is handled additional costs accrue, and it may be that although successful as a process, the advantages gained would prove insufficient to warrant the higher costs ensuing from the extra manipulation. Sisal has been successfully used for paper manufacture, for insulation, both thermal and electrical, and a number of other purposes where special characteristics are called for, but in most suggested uses where mere replacement of an already suitable material is contemplated, one has to consider the economic aspect in relation to the properties of the competitive materials.

Such uses as are outlined above create only a small demand at most, and therefore it behoves everybody interested to promote investigations and to study the requirements of our newer industries to see where Sisal can find a place in their organisation, processing or products. Such developments can only ensue when the fullest knowledge of the characteristics of the fibre is attained, for the natural corollary to such acquisition is to know how Sisal would respond to certain required conditions and treatments, as also to be able to prescribe with a degree of certainty how to render it into any required form as desired by modern industry and everyday life.

The Utilisation of Sisal Waste

1. *Paper Pulp Production.*—Three sources of waste products may be considered from the point of view of paper manufacture :—

- (a) The waste products of decortication.
- (b) The stems of the plants.
- (c) The poles or flowering stems.

The disposal of the decortication waste or megass is of considerable importance to the Sisal grower since for every 3 or 4 tons of fibre produced, there are 97 or 96 tons respectively of the waste products for disposal. The yield of fibrous waste is about 0·5 per cent. on the weight of the leaves and when separated this can be used for the preparation of paper pulp. It is necessary to clean the fibre somewhat before treatment in order to remove extraneous impurities and so prevent the occurrence of impurities, which exhibit themselves as black spots and are difficult to bleach.

From a French source, figures are quoted for costs of production. Michotte quotes the result of investigations which would indicate that the residues from 100,000 leaves (approximately 120,000 kilos.) when treated with 1 ton of caustic soda and 250 kg. of bleaching powder, would yield 1,220 kg. of pulp which was valued at 25 to 30 francs per 100 kg. These figures are set forth to support an argument that the preparation of paper pulp from the residues is not an economic proposition.

2. *Preparation of Pulp from Fibrous Waste.*—The preparation of pulp from the fibrous waste has been investigated by the Imperial Institute, London, upon Sisal waste composed of rather coarse, tangled, pale brownish yellow fibre, varying from 6–30 in. in length.

The material was dusty and contained much adherent epidermal matter and shrivelled cellular tissue. Four trials were made in the last one of which the material received preliminary mechanical treatment to cleanse it somewhat of the deleterious matter. The following table, taken from the Imperial Institute Bulletin, Vol. 28, No. 4, 1930, summarises the results :—

	Trial A.	Trial B.	Trial C.	Trial D.
Parts of caustic soda per 100 parts of fibrous waste.	20	20	20	20
Parts of caustic soda per 100 parts of solution	3	3	4	3
Time of digestion in hours	4	4	5	4
Temperature of digestion °C.	150	150	160	160
Caustic soda consumed per 100 parts of waste	11·4	12·0	12·4	9·8
Yield of dry pulp on dry weight:—				
Unbleached	48%	47%	44%	53%
Bleached	46%	46%	42%	50%

Trial A yielded pulp which did not bleach well, as the digestion was incomplète. Trial B gave pulp similar to A, but better dis-integrated, whilst trial C furnished a pulp which was superior to A or B in bleaching properties. Trial D, however, was performed upon fibre which had been mechanically treated to eliminate the presence of adhering epidermal matter and tissue, and the result gave a satisfactory pulp which was bleachable. A yield of 50 per cent. of bleached pulp was obtained, equivalent to 35 per cent. on the original untreated material. The conclusions arrived at state that "good yields of strong, long-fibred paper pulp can be obtained from this Sisal waste, under relatively economical conditions of treatment, but some difficulty would be caused by the cellular and other extraneous matter present if the waste were employed in its original condition." This, however, can be mechanically removed, but, of course, this entails additional expense.

Nevertheless, machines have been constructed for cleaning the fibre, and if this was done at the source, the proposition would possibly be economic.

A further investigation of the suitability of fibrous Sisal waste for paper pulp manufacture, is reported by Lorentz in "Der Tropenpflanzer" (31, 1928, p. 428, *et seq.*). In his experiments he used more caustic soda than the Imperial Institute experiments. The waste used contained 20·16 per cent. of moisture, and when treated with 8 volumes of 8 per cent. caustic soda for 3 hours of 8 atmospheres pressure, he obtained a yield of 35·6 per cent. on the air dried waste and 44·6 per cent. upon the dry weight. The pulp is described as bleachable, but tender. He repeated the experiment with a sulphate lye equivalent to 61 gms. of alkali per litre. After treatment for 3 hours under a pressure between 2 and 3 atmospheres, he obtained a yield of 52·11 per cent. on the dry matter. He records that the pulp had not good cohesion or strength even when prepared by the latter gentle treatment.

3. *Utilisation of Sisal Stems.*—Lorentz also investigated the possibility of the preparation of pulp from the stems. He divided the material into two classes, namely: (1) the Stipules, which gave a yield of pulp of very poor quality and quantity, being only 4·5 per cent., i.e. 14 per cent. on the dry matter, and (2) the inner woody part, which also gave a very poor pulp and a yield of only 9 per cent., i.e. 20·9 per cent. upon the dry weight.

4. *The Poles or Flowering Stems as Source of Paper Pulp.*—Under the same conditions of treatment as are described above, Lorentz obtained a pulp which was of better quality than that from other materials, also an enhanced yield of 41 per cent., being 51 per cent. on the dry matter. His conclusions indicate that from his point of view the flowering stems yield the best and most economic material. Assuming, however, that the manufacture of pulp from this material would be an economic proposition, he points out that the largest plantation could only yield sufficient raw material to enable the smallest unit for efficient paper manufacture to function at one-third of its capacity. Transport, on the other hand, is economically out of the question where such raw materials are concerned. Taking into view other sources of paper pulp manufacture, the question seems to be one requiring very careful deliberation. The results of Lorentz have been corroborated elsewhere, and his conclusions have in general been accepted. The materials described might be successfully worked if they could be sufficiently concentrated in quantity at any one place, but the nature of Sisal cultivation hardly permits this to be possible economically.

Imperial Institute Investigations

Investigations regarding the suitability of Sisal boles and poles from Kenya Colony have also been carried out at the Imperial Institute (Bull. Imp. Inst. 27, 3, 1929). The results of their experiments show that the boles, leaf bases and poles all furnish good yields of unbleached pulp.

The pulps from the boles and leaf-bases, however, were of unsatisfactory quality, being composed principally of short, broad fibres which, when wet, possessed little strength or felting power. The paper produced in these cases showed considerable shrinkage; it was hard, coarse and rattly, and contained numerous dark-coloured specks. There was, moreover, a very appreciable loss in the bleaching experiments, whilst neither the pulp from the boles nor that from the leaf-bases would bleach satisfactorily, and specks still persisted to a large extent in the papers. In addition, the materials contain pithy matter which adversely affects the quality of the pulp, causing shrinkage on drying. The removal of part of it in the case of the boles by mechanical means did not materially improve the quality, showing that the fibres of the materials do not possess satisfactory felting power.

On the other hand, the poles furnished an excellent yield of pulp, which, when prepared under the conditions of Trial B, bleached fairly readily. The paper was, moreover, very different in character from those produced from the boles and leaf-bases, being of much superior quality; it showed no appreciable shrinkage on drying, was fairly hard and strong, and the bleached paper, though not very opaque, was of fairly good quality, and free from specks.

From the results of this investigation, it would thus appear that the pole is the only portion of the Sisal plant represented by the present samples, which would be of interest for paper-making. Pulp prepared from the poles could be employed in the manufacture of brown wrapping paper, or after bleaching (which is fairly readily accomplished), for the production of strong white paper of fairly good quality. The yield of pulp was also quite satisfactory.

The Fermentation of Sisal Waste for the Production of Alcohol

The juice of certain plants of the Agave species is fairly rich in sugar. In Mexico it is fermented to yield a native wine known as "pulque," which, on distillation, yields a liquor of high alcoholic

content known as "mezcal". In general, however, the juice of the plants which yield the most fibre contains the least fermentable sugars. The problem of the utilisation of the decortication waste from Sisal extraction has led to a great deal of interest as regards the possibility of production of industrial alcohol therefrom, for utilisation as motor fuel, etc., which would be an economic by-product. The possibility of fuel production from the waste was investigated from two aspects, namely, the fermentation of the sugars in the leaf and stem juice to produce alcohol, and the fermentation of the products of hydrolysis of the hemicelluloses (pentoses) by bacteria to produce mixtures of alcohol and acetone. An analysis of Sisal waste, due to M. d'Herelle, quoted by Michotte, is of interest and importance in this connection :—

Composition of Agave Leaves. Analysis, due to d'Herelle

1,000 leaves, when treated, yielded the following quantities by weight :—

Leaves, 611 kg.	{	Fibres, 32 kg. Fibrous waste, 3.5 kg. Residues, 546 kg.	{	Juice, 432 litres. Residues, 96 kg. (50 per cent. water).
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The composition of the waste was given per 1,000 as :—

Dry matter, 168	{	Fibres, 34 or 23 per cent. Residues, 134 or 79 per cent.	{	Soluble matter, 93 or 69.4 per cent. Insoluble matter, 41 or 30.5 per cent.
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d'Herelle further gives analyses of the soluble and insoluble matters as :—

<i>Composition of Soluble Matters.</i>	<i>Per cent.</i>
Mineral matter	5.53 : 5.93
Nitrogenous matter	1.87 : 2.01
Reducing sugars.. .. .	19.30 : 20.75
Non-reducing sugars	38.41 : 41.31
Carbohydrates	27.83 : 29.92

<i>Composition of Insoluble Matters</i>	<i>Per cent.</i>
Mineral matter	3·94 : 9·61
Nitrogenous matter	1·47 : 3·58
Cellulose	20·21 : 49·30
Wax	0·27 : 0·66
Vasculose (ligneous)	15·11 : 36·85

Similar figures are also quoted by Baud in the *Comptes Rendus*, 1926. All figures given for the saccharine content of the leaf juice show considerable variation, according to the season of the year. During the dry season the juices become much more concentrated. A further variation is exhibited, according to the district in which the plant is grown, thus, in British East Africa, Michotte gives the sugar content as 3 per cent., whilst Fouque gives the value for French Sudan as 8·1 per cent. (after inversion). Bruno and Sorges (*L'Agricultura Coloniale*, May, 1923) give a figure of 2·27 per cent. for the fermentable sugars in the juice of Agave plants grown in East Africa. They state that they obtained a yield of alcohol on fermentation of 167 litres of absolute alcohol from 20,000 litres of juice, which they estimate is the product of 1 hectare. They contrast this with the yield of 321 litres from 1 hectare of sugar beet containing 16 per cent. of sugar.

The Fermentation of the Juice

The freshly expressed juice rapidly undergoes acid fermentation and an early sterilisation is essential if the sugars are to be preserved for alcoholic fermentation. Michotte quotes the following figures, due to d'Herelle, to illustrate this fact :—

Quantity of sugar in :—	<i>Waste.</i>	<i>Juice.</i>
After 1 hour	6·70	6·84
" 3 "	6·65	6·77
" 5 "	6·51	6·61
" 7 "	6·15	6·25
" 9 "	5·20	5·21
" 10 "	4·50	4·38

Bruno and Sorges determined the increase in acidity and found that it rose in some cases as high as 4 per cent. in four days (calculated as oxalic acid). It is probable that lactic acid is the most important product of this fermentation. Its presence in the juice was observed by McGeorge. (*J. Amer. Chem. Soc.*, 1912, 34, 1625.)

In order that alcoholic fermentation shall proceed normally, it is necessary to add alkali in some form.

The process recommended by d'Herelle is to press out the juice in a suitable mill, to filter, and then to sterilise by heating for 20 minutes at 120° with 1 per cent. sulphuric acid. After cooling the acidity is adjusted and the fermentation carried out, using a wild yeast from the plant. He obtains a yield of 17 litres from 1,000 leaves (611 kilos.). He estimates that from a plantation of 500 hectares, 7,400 hectolitres of 90 per cent. alcohol can be produced. Baud, however, estimates about half that quantity; d'Herelle also states that the juice of the stems is richer in sugar than the leaf juice.

The matter is more fully considered in the report of the French Government (Rapport du Comité scientifique du pétrole au Conseil d'administration de l'Office Nationale des Combustibles liquides, concernant les travaux exécutés par la Mission Fouque). The report finds that the juice of stems is not richer in juice than the juice of the leaf and records that the juice contains 2.3 per cent. of reducing sugars and 8.1 per cent. of sugars after inversion, of which all but 1 per cent. are fermentable. The wort obtained by fermentation contained 3.7 per cent. of alcohol. The process employed consisted of filtering the juice, then heating to sterilise and coagulate albuminoids and chlorophyll, clarification, neutralisation and cooling. For fermentation, a special yeast derived from the Agave plant is used. In distillation, some difficulty was found with frothing. The report is somewhat adversely criticised by Michotte, on the grounds that insufficient detail is given as to the scale of the experiments, of the method employed to obtain and grow the yeast, and of the distillation conditions. Fouque estimates the cost of producing alcohol under these conditions as 45-80 francs per hectolitre, but Michotte contends that this estimate is based upon insufficient data. A patent covering the process has been granted to Fouque. (B.P. 301,284).

Other patents covering various methods of treating the juice are L. Lavedan, B.P. 101,261, U.S.P. 1,182,691 (1916) who suggests neutralising with soda ash and then boiling with the addition of sulphur dioxide, skimming and allowing to settle, and H. J. Boeken German Patent 254,836 (1910) which covers a process for recovering wax and acids from the juice.

Industrial Exploitation

From the foregoing details it will be seen that the probability of successful utilisation of the waste for alcohol production will depend upon whether the yield of sugar in the juice is sufficiently high to make the process economic. At the present time a large number of starch and sugar containing substances are available for alcohol production at comparatively low prices. It is interesting to note that Michotte states that a distillery has been established at Merida in Yucatan, which is obtaining a yield of 30 litres of alcohol per ton of leaves.

The Fermentation of the Insoluble portion of Sisal Waste

In the fourth Memorandum upon Fuel for Motor Transport, issued by the Department of Scientific and Industrial Research, an account is given of experiments upon cellulosic materials of diverse origin with a view to studying the production of alcohol-acetone mixtures by fermentation. Among the materials so critically examined was Kenya Sisal waste. The report points out that the materials investigated consist not only of cellulose but also contain more than 50 per cent. of hemicelluloses and lignoses which differ fundamentally from cellulose in their chemical constitution and in their behaviour towards micro-organisms. In view of the fact that at one time no process was known which would convert the materials by a simple biological process directly into alcohol, it was considered desirable to evolve an efficient method for hydrolysis of the hemicellulose constituents of cellulosic materials so that the monosaccharides produced might be subsequently fermented. Whereas cellulose cannot be broken down into glucose except by the use of very concentrated acids such as are used in the Prodor process, the hemicelluloses are much more easily hydrolysed. Cognisance had to be taken of the difficulty of obtaining acids in large quantities in places where sufficient quantities of raw material might be available, the investigations were limited to dilute acid hydrolysis of the hemicelluloses and the subsequent fermentation of the resulting pentose sugars. As new types of vegetable material became available for the work, their hemicellulose content was determined and the maximum amount of fermentable copper-reducing substances yielded on hydrolysis with dilute sulphuric acid was ascertained. Sisal hemp waste from Kenya gave a yield of copper reducing substances calculated as pentoses of 5.5 per cent. The extract was found to be

highly fermentable both alone and with less readily fermentable materials. To obtain satisfactory results with weak acids it was necessary to use very high temperatures and it was noted that even with the highest acid concentrations employed, the temperatures had to be maintained above 100° C. to secure a complete extraction of the fermentable carbohydrates. Whilst on a laboratory scale, hydrolysis under pressure offered no serious difficulties on a technical scale, the necessity for such treatment would be a serious obstacle, not only on account of the added consumption of heat, but also on account of the difficulty of obtaining acid-proof pressure vessels. Obviously a more practical method had to be devised and it was noted that in the Amylo and Boulard processes, starch and grain, when soaked with water containing small quantities of mineral acids, are able to absorb this acid completely, and the subsequent heating of the mixture can be accomplished without damage to pressure vessels used for hydrolysing the grain.

Resort was therefore made to a similar device and the straw or other material used was steeped in comparatively strong acid, drained and then steamed for about six hours at atmospheric pressure. It was found that the hemicelluloses adsorbed sufficient acid from the solution to accomplish their hydrolysis when steamed. With Sisal waste the yield of sugars (calculated as pentoses), when the material was heated at 30 lb. pressure for one hour with an excess of sulphuric acid (1 : 12.3) was 5.5 per cent. When this material, after steeping for a short time in 2 per cent. sulphuric acid and draining, was steamed for six hours, a yield of 5.25 per cent. was obtained. The difficulty of transport of sulphuric acid was realised and oxalic acid was found to give satisfactory results as a hydrolysing agent.

A 2.8 per cent. solution of oxalic acid was necessary to liberate the pentoses under standard working conditions, owing to the presence in the oxalic acid of two molecules of water of crystallisation. The extracts prepared with oxalic acid were highly fermentable. Bacteria capable of converting pentoses to alcohol have long been known, but after careful experiment and selection the bacterium chosen for the present work was the *Bacterium acetoethylicus*, which was found to ferment the pentoses successfully to form alcohol and acetone. In the case of Sisal residues, the rate of fermentation was found to proceed at a maximum without the addition of food substances for

the culture, whilst other substances such as maize cobs required additional nitrogen to secure complete fermentation. When Sisal waste was mixed with the maize cobs it supplied the nutrition necessary and the mixture fermented readily. The following table, taken from the report, illustrates this point effectively :—

Sample.	Duration of fermentation.	Concentration of copper-reducing substances as pentoses.		Copper-reducing bodies present in extract.	Yield of alcohol-acetone mixture.	Percentage of acetone in mixture.
		Before fermentation.	After fermentation.			
	Days.	%	%	%	%	%
Sisal hemp residue	5	1·10	0·20	27·2	33·0	7·0
Maize cobs ..	11	1·57	0·78	14·6	30·4	3·0
Maize cobs plus Sisal hemp residue, equal parts.	6	1·82	0·20	29·0	32·5	6·0
Maize cobs plus Sisal hemp residue, equal parts.	7	1·58	0·15	32·5	35·9	7·0
Maize cobs plus 20 per cent. Sisal hemp residue.	9	2·37	0·10	33·0	34·9	7·0

The experimental work led to the conclusion that *Bacterium acetoethylicus* gives appreciable yields of ethyl alcohol and acetone from the carbohydrates extractable from the vegetable matters considered and that the conditions governing their conversion are such that application on a commercial scale is possible. The use of the steeping and steaming process simplified the nature of the plant required, the sterilisation of the mash being accomplished in the steaming vat thus dispensing with expensive pressure sterilisers. On a laboratory scale, Sisal waste when fermented gave a yield of acetone-alcohol mixture of 4·8 gallons per ton of raw material. A suggested plant for bulk work is set forth fully in the report and may be briefly reviewed.

The raw material, suitably chopped or disintegrated is first placed in a steeping vessel of wood fitted with means for stirring or agitation and a quantity of 2 per cent. sulphuric acid run in, the whole mass being well mixed. The steeped material is then run out of the steeping vessel and the excess acid squeezed therefrom by means of suitable rollers. The impregnated material is then steamed in vats of wood or non-corrosive material of special construction for the purpose and the whole mass is subsequently treated with sterilised water. The extract, neutralised with a sterilised suspension of lime then enters the specially designed fermenting tank, which could be constructed of wood, steel or cast iron, and is provided with steam pipes, jets, an air filter, man-hole, connecting pipes, etc. The mash is inoculated from a smaller fermentation vat, the liquid being fed in slowly so as to meet always a large volume of briskly fermenting mash. Fermentation being complete, the liquor can be run off to the stills. The plant would be entirely enclosed in order to secure fermentation under aseptic conditions. Full details are available in the report which envisages no insuperable technical difficulties, in the bulk process, once there is an assured supply of cheap raw material available at a definite location. It is suggested that the problem, so far as waste materials which require little or no further collection are concerned, i.e., materials where large transport charges are unnecessary, should be investigated from the point of view of the suitability of and to local conditions. The subject has been continually reviewed from time to time and as recently as December, 1932, a further discussion on the subject was published by the Society of Chemical Industry.

Cellulosic Fermentation

In a paper presented to the Society of Chemical Industry in November, 1932 (Vide. J.C.S.I., Dec., 1932), H. Langwell, of the Distillers Co., Ltd., Research Department, gave a survey of experiments conducted by himself and colleagues upon the fermentation of cellulosic materials. He outlined the steps taken to overcome many of the difficulties associated with the fermentation of cellulose on a practical scale, including references to Sisal waste. One of the chief difficulties lay in the nutrition of the bacterial culture employed, and earlier experimenters had experienced a slackening off in the rate of fermentation after a short time. The trouble had been diagnosed as due to the presence of calcium carbonate, added with a

view to neutralisation of the acidity, and which had the effect of removing soluble phosphates from solution. Sodium bicarbonate proved an efficient substitute, however, the cellulose fermentation proceeding more or less to completion. The main product of such fermentation was acetic acid, together with some butyric acid, accompanied by the evolution of methane gas. If, however, the fermentation was prosecuted under aerobic conditions, alcohol was also produced in considerable quantities. J. J. Fox, in the course of the discussion, stated that large quantities of cellulose waste were available in the form of Sisal waste from decortication and in reply Langwell called attention to the fact that unfortunately Sisal contained an effective amount of calcium carbonate which proved a difficulty, but otherwise was highly suitable on account of its large cellulose content. Following up this discussion, Langwell at the author's invitation, kindly enlarged upon this statement in a privately communicated note for this treatise, which is appended below. There is one point to note, however, with regard to the calcium carbonate content, namely that many other observers call attention to the high content of calcium oxalate in the Sisal fibre, and in the ash calcium carbonate occurs as a result of incineration.

" In 1921, The British Central Africa Company was stated to be interested in the utilisation of the waste products from Sisal fibre production. They submitted a sample bale, which when received appeared to be a mixture of fibre, dried pulp and portions of leaves. It contained :—

	<i>Per cent.</i>
Dry ash-free organic matter	76.8
Ash	11.6
Loss at 100° C.	11.6

" It was examined by the method in use at that time, and found to be fermentable without preliminary treatment to the extent of about 40 per cent. A gentle digestion with 15 times its weight of 5 per cent. caustic soda at 100° C. for 60 minutes and a similar treatment with 5 per cent. sulphuric acid raised the fermentability to about 64 per cent. Some treatment, either mechanical or chemical, was deemed necessary on account of the mechanical difficulty of handling such a tough matted mass of fibres.

“ A similar preliminary examination of a sample of alleged Sisal waste from Jamaica was made in 1923. This sample was very small and had been dispatched in the wet condition ; it had possibly fermented en route. As received it gave 78 per cent. loss at 100° C. The dry material contained :—

	<i>Per cent.</i>
Water insoluble organic matter ..	54.3
„ soluble organic matter ..	8.7
„ insoluble ash	21.6 (largely CaCO ₃).
„ soluble ash	15.4

“ The material as received consisted chiefly of pulp and cortical tissue and fermented to the extent of 33 per cent. After a light lime boil this was raised to 45 per cent. This sample was too small for further investigation and there existed some doubt as to its true nature and freshness.

“ The above results were obtained before the modern improved technique was introduced, so that they mean little more than that both pulp and fibre of Sisal waste are probably fermentable, especially after some slight preliminary treatment. The origin of the CaCO₃ in the ash was not investigated, nor was it certain that it existed as CaCO₃ in the original material. (*Note.*—The origin has recently been identified as due to Calcium oxalate in the raw material.)

“ The question of the utilisation of this waste fibre and pulp in Central Africa was not more fully gone into at the time owing to the very primitive conditions under which any process would have had to work. The matter was consequently dropped and tests of this material under modern conditions were never made.

“ This briefly outlines the present position. With regard to the economic possibilities of re-opening this question, it should be borne in mind that the question of transport of raw material and finished product might be difficult to solve, and further, the potential market for acetic acid during recent years appears to have contracted largely on account of the improved modern methods of recovering acetic acid.”

It is obvious therefore that considerable further investigation has yet to be made before concrete steps can be taken to establish the cellulose fermentation industry on a commercial basis in order

to utilise the waste from Sisal decortication. Other uses have been suggested for this waste such as e.g. its admixture with plastics and subsequent compression into slabs for building and other purposes.

A glimpse at the contour of the Sisal fibre will illustrate its particular suitability for plastic reinforcement. Besides its absorbent properties, it has an irregular contour almost of the horse shoe shape type, whilst the smooth highly varnished surface of coir or similar fibres is largely subordinated. The re-entrant portion serves to hold the plastic securely and thus prevent the slipping out of the short fibres from their position in the matrix, which occurs with more regular shaped fibres. The adhesiveness of the plastic composition is thus enhanced and the reinforcing action is strengthened.

Dyeing of Sisal

According to Wilkinson, the treatment of Sisal for dyeing closely resembled that of cotton. Grove-Palmer, in an article on this subject in the "Dyer and Calico Printer" states that Sisal can be dyed by either acid, basic or direct dyes. The process of dyeing with acid dyestuffs is to use a bath as small as possible in volume and which contains no Glauber's salt. It may be either neutral or acidified with from $\frac{1}{2}$ -3 per cent. formic acid, according to requirements. The actual dyeing should take place at the boil and occupies from $1\frac{1}{2}$ -2 hours. For direct colours the dyeing is carried out normally, but it is essential to add a proportion of soda ash to counteract the effects of a small quantity of tannin or natural acidity in the fibre. Basic dyes produce very bright shades and when fastness to light is not of prime importance, they are much used. No mordant is necessary, a factor attributed to the presence of a small quantity of tannin in the fibre. Grove-Palmer states that the bath must be gradually raised to the boil and kept at that temperature for at least 1 hour. From 1-3 per cent. formic acid is used, which, in order to increase penetration, may be increased up to 5-6 per cent.

In the case of very light shades a preliminary bleaching is carried out utilising hydrogen peroxide and ammonia, but if well sunbleached or treated with ionised oil, this is hardly necessary, especially in the latter case. After dyeing, the ordinary washing and drying is carried out. In this regard it differs from some of the coarser fibres which are customarily left unwashed and dried in that condition, but in the case of Sisal, a more delicate substance is being treated and greater care is required in handling it chemically.

CONCLUSION

The purpose of this booklet is to call attention to the paucity of real scientific knowledge of the attributes and characteristics of the Sisal fibre.

It is extraordinary how, when one sets out to compile or collect data relevant to a particular subject, the gaps in our knowledge become painfully obvious. So it is with the present work. The Imperial Economic Committee's Report on Hemp Fibres is a document worthy of mature consideration, and one would call special attention to the points raised with regard to the necessity for research work. They not only point out the need for the investigation of production methods and costs, the improvement of fibre quality, but they record the suggested programme of research work at Amani, which includes questions of fibre extraction.

In outlining the various items of research essential for the development of Sisal, the Imperial Economic Committee state in research matters "it is probably unnecessary to defer action until all parts of the schemes become financially possible." This is a suggestion which ought to be considered by all interested immediately.

In calling attention to the declining markets for the products of Sisal in certain directions and in advocating the development of other uses, the Imperial Economic Committee's Report certainly emphasises the need for research upon the fibre itself with a view to its wider utilisation. Research on production alone will probably lead to enhanced quantities of excellent fibre becoming available. If this cannot be absorbed in Industry, then such research work will prove abortive. It was with this idea in mind that the present treatise was compiled in order to survey our knowledge of the Sisal fibre apart from its agricultural aspect, and thus to lay the foundations of something that might serve as a basis for future development of an industrial character with a view to its wider utilisation.

If new knowledge of the properties of Sisal follows and it is possible to predict with any certainty its response to treatments or processes, then Sisal might find new places in some of the more modern and new industries which are springing up so rapidly around us. Without such fundamental knowledge being available, the claims of Sisal will be largely ignored.

Research work on both production and utilisation is the life blood of the industrial future; and if such work is restricted in volume, there will not be that progress which is so essential for Imperial welfare. There are those who, remembering that science has made possible the invention of the harvester-thresher machine, would, with some tinge of bitterness, point to the results of scientific investigation upon the use of binder twine and say that history will inscribe its records "*How* Science did for Sisal". Our motto should be that such records should read "*What* Science did for Sisal", and to change "how" to "what" needs co-operative effort, scientific, commercial and financial.

It is possible that many of the new uses to be found for Sisal such as, e.g., its admixture with plastics as already described, will not involve what might be called the textile aspect of the subject. On the other hand, such developments are bound to create demand for the raw material. It is obvious, therefore, that the producer is bound to benefit in any case by such developments, and it is largely in his interests that such work should be encouraged and promoted.

Thus, at the conclusion of this small attempt to collect the scattered items of scientific knowledge concerning the fibre, one is inclined to take an optimistic view of the future, for if Sisal could have done so much as it has done commercially on so little knowledge as is now available, the future should be assured if greater and wider information is obtained. Our tropical Empire is rich in undeveloped fibres of all types. It is rich in fibres similar to Sisal and as a result of a progressive agricultural policy the production of such raw materials has increased enormously.

Utilisation has not been developed at anything like the same rate and hence we find, in many cases, prices of the raw material falling and stocks of such materials accumulating. We must ask ourselves the question as to whether, in order to assure the future of the Empire whose products are so bounteously presented to us, science should not be given an adequate opportunity to show the way.

The light of scientific knowledge, however, cannot shine unless the burner is liberally supplied with energy of the right type for its consumption. The intensity of illumination will be proportional to the number of lamps and the amount of suitable energy available; in other words, scientific progress in the industry is dependent upon the number of workers or investigators employed and the financial

support secured for the work. Otherwise, the illumination of the path of progress of the Sisal Industry will be dim and its steps forward into the future will be slow and hesitating.

It is essential, therefore, that the co-operation of everybody should be sought for the development, exploitation and utilisation of such important Imperial fibre products as Sisal, and thus by so doing we shall assist in the realisation of part of our long-cherished hopes of Empire Trade recovery, which is so essential to the welfare of us all.

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FRUIT SUPPLIES IN 1932

(INCLUDING VEGETABLES, FLOWERS AND BULBS)

PREPARED IN THE STATISTICS
AND INTELLIGENCE BRANCH OF
THE EMPIRE MARKETING BOARD



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FOREWORD

THE present volume is the third in the series of Annual Reviews of Fruit Supplies in the United Kingdom, and follows precisely the same lines as previous volumes. In this volume the statistics for the year 1931 have been revised, while statistics for 1932 are provisional throughout the volume.

Following upon the introduction of import duties over a wide range of fruits and vegetables last year, the time lag, normally inconsiderable, between actual imports and the passing of Customs entries, was temporarily increased. In the tables showing monthly imports which appear in the pages of this Review, adjustments have been made in the official figures to bring them into line with the figures of actual arrivals obtained from the Board's records of shipments afloat.

STATISTICS AND INTELLIGENCE BRANCH,
EMPIRE MARKETING BOARD.

June, 1933.

FRUIT SUPPLIES IN 1932

STERLING EXCHANGE AND IMPORT DUTIES

Two factors, both absent during the greater part of 1931, and in earlier years, tended to reduce imports of fruit and vegetables from most foreign countries into the United Kingdom throughout the course of the year 1932. The first of these, the abandonment of the gold standard by the United Kingdom, had occurred in September, 1931, and affected all the important foreign countries which ship fruit and vegetables to the British market. The second, the imposition of import duties upon fruit and vegetables from foreign countries, was first introduced at the beginning of 1932.

Neither of these two factors directly affected producers in the British Empire with the exception that the South African and Canadian growers suffered, the Canadian to a less extent than the South African, from the depreciated United Kingdom pound. The import duties were not applied to fruit imported from any country in the Empire, and throughout the Empire, except in South Africa and Canada, exchange rates followed sterling; producers in Australia and New Zealand, in fact, continued, as in 1931, to gain some advantage from the depreciation of the Australian and New Zealand pound as against sterling.

The effect of the depreciation in sterling and the incidence of import duties over the whole range of fruit and vegetables imported, is apparent in the pages which follow. In general, the growing imports of foreign produce have been checked, and imports from the Empire expanded. But the tendency is not uniform. Some foreign countries are so dependent upon the United Kingdom market for the disposal of their surplus produce that exports in 1932 were hardly diminished, or were even increased if crops were favourable. On the other hand, however favourable market conditions may have been, Empire countries could only expand their exports to the extent that the crops permitted, and in some cases the crops were lighter than in 1931.

Sterling Exchange

Until the United Kingdom left the gold standard, the currencies of most countries which export fruit and vegetables to this market were approximately on a parity with sterling. Exceptions were Australia and New Zealand in the Empire, and Spain, Argentina, and Brazil among foreign countries. The sterling exchange value

of the currency of each country, expressed as a percentage of its par value in January and before sterling left gold in September, 1931, was as follows :—

Country.	Percentage of par value.	
	January, 1931.	1st-17th September, 1931.
Australia	83·3	76·7
New Zealand	94·0	91·3
Spain	54·5	46·8
Argentina	75·1	65·6
Brazil	76·1	49·6

The effect of sterling's departure from gold was to reduce the competitive power in the United Kingdom market of countries remaining on gold. After a shortlived rise, commodity prices in the United Kingdom again began to fall, and average declared import values of many fruits were lower in 1932 than in 1931. In the following table are shown the average quarterly rates for sterling on certain countries, which ship fruit and vegetables to the United Kingdom, expressed as percentages of the rates ruling at the beginning of September, 1931.

Country.	Oct.-Dec. 1931.	Jan.-Mar. 1932.	April-June 1932.	July-Sept. 1932.	Oct.-Dec. 1932.
U.S.A.	75·3	72·5	76·0	72·1	68·3
France	75·2	72·0	75·6	72·1	68·4
Netherlands	75·5	72·4	75·8	72·0	68·3
Spain	80·2	79·2	87·5	80·4	76·0
Italy	77·3	74·1	78·0	74·3	70·4
Argentina	83·6	77·6	86·5	—	72·7
Brazil	77·9	73·6	66·2	59·5*	56·1*
Canada	86·6	82·7	85·9	81·5	77·2
Union of South Africa	77·0	74·2	77·3	73·2	69·4†

* Nominal.

† Up to 27th December.

Among fruit exporting countries in the Empire Canada and the Union of South Africa were both affected by the United Kingdom's departure from the gold standard, South Africa more than Canada,

whose dollar depreciated less than sterling. To counteract the loss on exchange, the South African Government granted bounties upon exports of a wide range of produce, including both citrus and deciduous fruits. The Australian and New Zealand pounds remained linked to sterling at a discount of 20 and 8·7 per cent. respectively throughout the year.

Import Duties

Import duties on certain foreign horticultural products entering the United Kingdom were introduced at the beginning of 1932. These were imposed by an Order issued under the Horticultural Products (Emergency Customs Duties) Act, 1931, and further Orders under this Act making additions or amendments to the products concerned or the rates of duty, followed during the early part of the year. As from 1st March, 1932, a duty of 10 per cent. *ad valorem* was imposed under the Import Duties Act, 1932, on all foreign products imported (with certain exceptions). The emergency duties were withdrawn during the summer and were replaced by a permanent schedule of duties by Orders issued under the Import Duties Act. These took effect from 28th July in the case of potatoes and from 1st September as regards horticultural products generally. Additional duties on certain fresh fruits were introduced on 17th November, 1932, by an Order issued under the Ottawa Agreements Act, 1932.

Particulars of the rates of duty actually in force from time to time during 1932, and the position from January, 1933, onwards, as it existed according to Orders in force at the beginning of the year 1933, are shown in the following table. From 1st March, 1932, the general duty of 10 per cent. *ad valorem* became chargeable on the commodities shown during all periods of the year not included in the table. All the dates quoted are inclusive.

United Kingdom Import Duties on Fruit, Vegetables, Flowers, etc.

Product.	1932.		January, 1933, onwards (a)	
	Duration.	Amount of Duty.	Duration.	Amount of Duty.
<i>Fresh Fruit.—</i>				
Apples (other than apples for cider making).	Nov. 17–Dec. 31	4s. 6d. per cwt.	Whole year	4s. 6d. per cwt.
Bananas	Nov. 17–Dec. 31	2s. 6d. per cwt.	Whole year	2s. 6d. per cwt.
Cherries	May 1–June 30	3d. per lb.	May 1–Aug. 15	3d. per lb.
Currants	May 1–July 31	2d. per lb.	May 1–Aug. 31	2d. per lb.

Product.	1932.		January, 1933, onwards (a)	
	Duration.	Amount of Duty.	Duration.	Amount of Duty.
Gooseberries	May 1-June 30	½d. per lb.	May 1-July 31	½d. per lb.
Grapefruit	Nov. 17-Dec. 31	5s. per cwt.	Whole year	5s. per cwt.
Grapes (hothouse)	Jan. 5-June 30	4d. per lb.	Whole year	3d. per lb.
	July 1-Aug. 31	2d. per lb.		
	Sept. 1-Dec. 31	3d. per lb.		
Grapes (other than hothouse)	—	—	Feb. 1-June 30	1½d. per lb.
Oranges	Nov. 17-30	3s. 6d. per cwt.	April 1-Nov. 30	3s. 6d. per cwt.
Peaches and nectarines (hothouse).	Sept. 1-Oct. 31	1s. per lb.	April 1-Oct. 31	1s. per lb.
Peaches and nectarines (other than hothouse).	Dec. 1-31	14s. per cwt.	Jan. 1-Mar. 31	} 14s. per cwt.
			Dec. 1-31	
Pears	Nov. 17-Dec. 31	4s. 6d. per cwt.	Whole year	4s. 6d. per cwt.
Plums	June 1-Aug. 15	14s. per cwt.	Jan. 1-Mar. 31	} 9s. 4d. per cwt.
	Sept. 1-Oct. 31	9s. 4d. per cwt.	June 1-Oct. 31	
	Dec. 1-31	9s. 4d. per cwt.	Dec. 1-31	
Raspberries and loganberries	—	—	July 1-Aug. 31	2d. per lb.
Strawberries	April 1-May 31	2s. 6d. per lb.	April 1-July 31	3d. per lb.
	June 1-25	6d. per lb.		
<i>Preserved Fruit.</i> —				
Fruit preserved by chemicals or artificial heat, other than fruit preserved in sugar.	April 26-Dec. 31	25 per cent. <i>ad valorem.</i>	Whole year	25 per cent. <i>ad valorem (a).</i>
<i>Fresh Vegetables.</i> —				
Asparagus	Jan. 5-Feb. 29	1s. per lb.	Jan. 1-June 30	4d. per lb.
	Mar. 1-May 31	4d. per lb.		
Broccoli and cauliflowers ..	Jan. 5-Mar. 31	4s. per cwt.	Whole year	3s. per cwt.
	April 1-June 30	3s. per cwt.		
	Oct. 1-Dec. 31	3s. per cwt.		
Carrots	April 1-June 30	1d. per lb.	Whole year	2s. 4d. per cwt.
	Oct. 1-Dec. 31	2s. 4d. per cwt.		
Cucumbers	Mar. 1-June 30	12s. per cwt.	—	—
	July 1-Aug. 1	8s. per cwt.		
Cucumbers (other than gherkins).	Sept. 1-Nov. 30	8s. per cwt.	Mar. 1-Nov. 30	8s. per cwt.
Green beans	Jan. 5-June 30	1½d. per lb.	Jan. 1-Aug. 31	1½d. per lb.
Green peas	Jan. 5-Mar. 31	14s. per cwt.	—	—
Green peas (unshelled) ..	April 1-June 30	9s. 4d. per cwt.	Jan. 1-July 31	9s. 4d. per cwt.
Green peas (shelled)	April 1-June 30	£1 17s. 4d. per cwt.	Jan. 1-July 31	£1 17s. 4d. per cwt.
Lettuce, endive, chicory (salad)	Jan. 5-April 30	8s. per cwt.	Jan. 1-April 30	8s. per cwt.
	May 1-June 30	6s. per cwt.	May 1-Dec. 31	6s. per cwt.
	Sept. 1-Dec. 31	6s. per cwt.		
Mushrooms	Jan. 5-Dec. 31	8d. per lb.	Whole year	8d. per lb.
Potatoes (new)	Jan. 5-Feb. 29	18s. 8d. per cwt.	Jan. 1-June 30	4s. 8d. per cwt.
	Mar. 1-31	9s. 4d. per cwt.	July 1-Oct. 31	£1 per ton (a)
	April 1-30	4s. 8d. per cwt.	Nov. 1-Dec. 31	4s. 8d. per cwt.
	July 28-Oct. 31	£1 per ton		
	Nov. 1-Dec. 31	4s. 8d. per cwt.		
Potatoes (other than new) ..	July 28-Dec. 31	£1 per ton	Whole year	£1 per ton (a)
Tomatoes	June 1-July 31	2d. per lb.	June 1-July 31	2d. per lb.
	Aug. 1-Oct. 31	1d. per lb.	Aug. 1-Oct. 31	1d. per lb.
Turnips	April 1-June 30	1d. per lb.	Whole year	2s. 4d. per cwt.
	Sept. 1-Dec. 31	2s. 4d. per cwt.		

Product.	1932.		January, 1933, onwards (a)	
	Duration.	Amount of Duty.	Duration.	Amount of Duty.
<i>Preserved Vegetables.</i> — Vegetables (other than tomatoes), preserved in air-tight containers, but not including pickles and vegetables preserved in vinegar.	April 26–Dec. 31	20 per cent. <i>ad valorem</i> .	Whole year	20 per cent. <i>ad valorem</i> .
<i>Flowers, Plants, etc.</i> — Cut flowers in the following varieties :— Anemones, carnations and pinks, heather, marguerites, marigolds, mimosa, narcissi (polyanthus types), star of Bethlehem, stocks, violets.	Jan. 5–Aug. 31	2 <i>d.</i> per lb.	—	—
Lilac, gypsophila, heather, peonies, marguerites, marigolds, mimosa, narcissi (polyanthus types), star of Bethlehem, stocks, violets.	Sept. 1–Dec. 31	2 <i>d.</i> per lb.	Whole year	2 <i>d.</i> per lb.
Other cut flowers	Jan. 5–Dec. 31	9 <i>d.</i> per lb.	Whole year	9 <i>d.</i> per lb.
Plants in flower	Jan. 5–Dec. 31	9 <i>d.</i> per lb.	Whole year	9 <i>d.</i> per lb.
Flowers attached to bulbs ..	Jan. 5–Dec. 31	9 <i>d.</i> per lb.	Whole year	9 <i>d.</i> per lb.
Other plants and roots of flowering plants.	Sept. 1–Dec. 1	6 <i>d.</i> per lb.	—	—
Other plants and roots of flowering plants (excluding lily of the valley crowns and roots).	Dec. 2–31	6 <i>d.</i> per lb.	Whole year	6 <i>d.</i> per lb.
Foliage (excluding asparagus foliage).	Jan. 5–Aug. 31	2 <i>d.</i> per lb.	—	—
Foliage (excluding holly, mistletoe, asparagus foliage and golden palm branches).	Sept. 1–Dec. 31	2 <i>d.</i> per lb.	Whole year	2 <i>d.</i> per lb.
Asparagus foliage	Jan. 5–Dec. 31	9 <i>d.</i> per lb.	Whole year	9 <i>d.</i> per lb.
Trees and shrubs (excluding rose trees, fruit trees, azalea indica and sweet bays) :—				
(a) Bare roots	Sept. 1–Dec. 31	20 <i>s.</i> per cwt.	Whole year	20 <i>s.</i> per cwt.
(b) Balled roots	Sept. 1–Dec. 31	10 <i>s.</i> per cwt.	Whole year	10 <i>s.</i> per cwt.
Rose Trees	Jan. 5–April 30	30 <i>s.</i> per 100	Whole year	25 <i>s.</i> per 100
	May 1–Aug. 31	20 <i>s.</i> per 100		
	Sept. 1–Dec. 31	25 <i>s.</i> per 100		
Fruit Trees and fruit stocks	Sept. 1–Dec. 31	20 <i>s.</i> per cwt.	Whole year	20 <i>s.</i> per cwt.

(a) According to Orders in force in January, 1933. Between that date and the time of going to press the following changes have been made: Preserved fruit—duty on dried apples, pears, peaches and nectarines changed to 10*s.* 6*d.* per cwt., and duty on dates to 10 per cent. *ad valorem*, as from February 28, 1933; potatoes, new and other than new—duty increased to £2 per ton from July 1 to August 31; potatoes, other than new—duty temporarily increased to £2 per ton from May 5 to June 30 during 1933 only.

The following special provisions are made in the Import Duties Act, 1932, or in the Ottawa Agreements Act, 1932.

Preference for Dominions, etc.—The duties are not chargeable on fruit consigned from any part of the British Empire and grown in any country the Government of which is a party to one of the agreements made at the Ottawa Conference, 1932 (i.e., Canada, Australia, New Zealand, Union of South Africa, Newfoundland, India, Southern Rhodesia).

Preference for Colonies, Dependencies, etc.—The duties are not chargeable on fruit consigned from any part of the British Empire and grown in any part of the British Empire other than the Dominions, India and Southern Rhodesia.

Mandated Territories.—The position of mandated territories is covered by the Import Duties Act, which provides that Orders in Council may be issued declaring that Colonial preference shall apply to any territory in respect of which a mandate of the League of Nations is being exercised by the Government of the United Kingdom. Under the Import Duties (Mandated Territories) Preference Order, 1932, it is provided that Colonial preference shall apply to Tanganyika Territory, Cameroons under British Mandate and Togoland under British Mandate.

Port of Beira.—Fruit consigned from the port of Beira in Portuguese East Africa and shown by a certificate signed by a Customs officer in the service of the Government of Southern Rhodesia, Northern Rhodesia or Nyasaland to have been grown in one of those three countries will be treated as if consigned from a part of the British Empire.

Apples for Cider-making.—Where apples imported into the United Kingdom are consigned direct to a registered cider factory the Commissioners of Customs and Excise may, subject to such conditions as they may impose for securing that the apples are used for the making of cider in that factory, allow the apples to be imported free of any duty chargeable under the Ottawa Agreements Order. (They are still subject to the general 10 per cent. *ad valorem* duty).

FRUIT PRODUCTION IN THE UNITED KINGDOM

Only minor changes were recorded in the commercial acreage under fruit in the United Kingdom in 1932. In England and Wales the area under orchard fruit increased by one per cent. from 244,778

to 247,304 acres while small fruit declined by four per cent. from 62,023 to 59,535 acres the net change, for orchard and small fruit, being an increase of only 38 acres. The Scottish acreage of small fruit increased by about 100 acres, from 8,200 to 8,300 acres, while in Northern Ireland provisional figures indicate an increase in the fruit area from 8,383 acres (in 1930) to 8,666 acres in 1932.

Production in 1932 was on the whole rather light. Figures are not available for Scotland or Northern Ireland, but in the former country the raspberry crop was exceptionally good, while strawberries were irregular. In Northern Ireland early varieties of apples were light but the late apple crop was about average although not up to the heavy 1930 output. In England and Wales, however, only strawberries and raspberries were up to the average of the preceding four years, and these two crops were lighter than in 1931. The cider apple crop was the lightest since annual estimates were first published in 1924.

England and Wales

Production of fruit in England and Wales during 1932 shows a slight increase in the aggregate by comparison with 1931. The apple crop was only moderate, but nevertheless there was a fairly substantial recovery in estimated production of dessert and cooking apples from the low yield recorded in 1931. Cider apple production, however, declined to a new low level, the estimated yield in 1932 being little more than a third of that in 1927.

Pears and plums show a slightly better yield than in 1931, and there was little change in regard to the estimated yield of cherries as compared with the previous year.

With regard to soft fruits the figures for 1932 show a decline in every case in comparison with 1931, but the estimated production of strawberries, although lower than in the previous year, was heavier than in any year since 1925. Raspberries and red and white currants were about average crops, but the yields of gooseberries and black currants were well below average.

The following table shows the estimated yields of the more important fruit crops in recent years compiled by the Ministry of Agriculture and Fisheries. As a result of the Census of Production in 1931 revisions have been made in the estimated production of

apples, plums and cherries in 1930 and 1931, and in the estimated production of currants and gooseberries in 1931, and the amended figures are shown in the table.

TABLE I.—*Fruit Crops in England and Wales, 1925–32.*

Description of Fruit.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apples—								
Dessert and cooking ..	6,520	1,116	5,947	2,906	6,415	3,944	1,574	2,515
Cider ..	1,160	1,035	1,846	1,335	1,145	973	747	691
Pears—								
Dessert and cooking ..	82	378	688	320	513	369	241	265
Perry ..	18	74	40	90	99	47	19	21
Plums ..	801	1,318	999	937	1,215	2,561	646	687
Cherries ..	349	195	304	209	296	466	267	266
Red and White								
Currants ..	66	63	84	53	74	89	84	65
Black Currants	188	177	212	210	254	260	231	155
Strawberries ..	705	667	404	395	340	379	717	607
Gooseberries ..	590	646	677	585	645	852	683	482
Raspberries ..	145	104	115	96	102	156	162	141

Scotland

Estimates of fruit production in Scotland are made by the Department of Agriculture at five-year intervals in connection with the Census of Agricultural Production, and a statement issued by the Department gives estimates of the production in 1930 of small fruit and fruit grown in orchards respectively.

Table II shows the acreage and production of small fruit in 1930 with comparative figures for 1925. In studying these figures it should be borne in mind that, according to the October, 1930, quarterly Horticultural Report of the Department of Agriculture, the yield of all kinds of small fruit in 1930 was unusually good, and raspberries were an exceptionally heavy crop.

TABLE II.—*Acreage and Production of Small Fruit in Scotland.*

Description of Fruit.	Total Acreage.		Acreage in Bearing.		Production.	
	1925.	1930.	1925.	1930.	1925.	1930.
Strawberries	2,477	2,106	1,990	1,663	51,500	42,500
Raspberries	3,152	4,561	2,732	4,030	84,500	155,400
Black currants	310	622	235	570	1,570	7,200
Red or white currants	210	134	179	123	2,080	3,400
Gooseberries	606	389	551	380	13,850	8,000
Other kinds	—	19	—	18	—	170
Mixed small fruit ..	434	401	412	393	5,150	9,800

In 1932 a slight increase was shown in the total acreage of small fruit, which was approximately 8,300 acres as compared with 8,200 acres in each of the two preceding years.

In Table III are shown the acreage and production of orchard fruits in 1930 with comparative figures for 1925. The October, 1930, Horticultural Report stated that the yield of apples was generally heavy in that year.

TABLE III.—*Acreage and Production of Orchard Fruit in Scotland.*

Description of Fruit.	Acreage.		Production.	
	1925.	1930.	1925.	1930.
Apples	350	291	4,650	11,300
Pears	120	128	1,085	1,300
Cherries	113	40	350	—
Plums	146	220	3,150	3,700
Other kinds	—	15	—	240
Mixed orchard fruit ..	434	310	2,375	9,150

The production of raspberries in 1932 was exceptionally good. Strawberry crops were irregular; in some districts the berries were plentiful, but elsewhere crops were light. Red currants were a fair crop, but black currants were disappointing and gooseberries were only a moderate crop. Apples were below average and crops of plums and pears were very light.

Northern Ireland.

Estimates of fruit production in Northern Ireland are made at intervals of five years in connection with the Census of Agricultural Production, and the latest figures with which the 1930 estimates may be compared are for the year 1925.

Full details of the estimated acreage under fruit are not available, but the area in 1930, excluding certain fruits of minor importance, totalled 8,383 acres, as compared with an aggregate acreage for all fruits of 9,346 in 1925. The acreage in 1932 is reported to have increased to 8,666 acres. Details are not available and this figure is subject to revision.

Table IV shows the estimated acreage and production of fruit in Northern Ireland in 1930, together with the production in 1925.

TABLE IV.—*Acreage and Production of Fruit in Northern Ireland.*

Description of Fruit.	Acreage in 1930.	Production.	
		1925.	1930.
		cwts.	cwts.
Gooseberries	138	4,853	8,500
Black currants	124	1,924	3,900
Red and white currants	(a)	493	(a)
Raspberries	86	1,490	2,600
Strawberries	585	7,970	32,000
Other bush fruits	(a)	926	(a)
Apples	7,450	27,380	640,000
Other tree fruits	(a)	612	(a)

(a) Not available.

In connection with these figures it should be borne in mind that, on account of bad weather conditions in the early part of the year, the fruit crop in Northern Ireland in 1925 was a very poor one. On the other

hand, in 1930, according to the Ministry of Agriculture's Monthly Reports, favourable conditions resulted in heavy yields. The production of apples was well above average, and soft fruits gave very good results.

Fruit crops in 1932 were favourably affected by good weather conditions. Early varieties of apples were light, but later crops generally were above the average of recent years, although not so heavy as in 1930.

THE PRODUCTION OF CROPS UNDER GLASS IN GREAT BRITAIN

Figures relating to the production of crops under glass in Great Britain in 1930-31 have been prepared by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland. The information is based on special returns received from producers in connection with the Agricultural Census, and may be compared with similar particulars published in respect of the year 1924-25.

The total area of commercial glasshouses in Great Britain is estimated at 3,350 acres in 1930-31, as compared with 2,800 acres in 1924-25, while the estimated total selling value of glasshouse produce is approximately £5,590,000 as against £4,950,000. The only description of glasshouse produce for which the estimated output is available in both England and Wales and Scotland is tomatoes, of which total production is estimated at 57,000 tons in 1930-31 as against 49,000 tons in 1924-25.

England and Wales

The total area of commercial glasshouses in England and Wales in 1930-31 is estimated by the Ministry of Agriculture and Fisheries at 3,150 acres, as compared with 2,725 acres in 1924-25, an increase of 15 per cent. The selling value of the produce in 1930-31 is estimated at about £5,350,000, an average of £1,700 per acre, as against £4,830,000, or £1,770 per acre, in 1924-25. This shows a decrease of 4 per cent. in the average selling value of the produce per acre, and since this decrease is much less than the general decline which has occurred over the period in selling prices of glasshouse produce, the returns indicate that in addition to a relatively substantial increase in area, there has been a material increase in the volume of the output per acre.

The production of tomatoes in 1930-31 is estimated at 54,000 tons, as against 47,000 tons in 1924-25, an increase of 15 per cent., while the output of cucumbers has risen from 50 to 54 millions. On the other hand the cultivation of grapes appears to have declined during the period, the returns indicating an output of 1,150,000 lbs. as compared with 1,500,000 lbs. No figures are published regarding the production of flowers, foliage and plants, but it is evident that there has been a very substantial increase in the output of this description of glasshouse produce, as the selling value of over £2,000,000 in 1930-1931 is 50 per cent. greater than that of 1924-25 in spite of a generally lower price level.

Details of the estimated production and selling value of the various kinds of glasshouse produce are shown in Table I.

TABLE I.—*Production and Value of Glasshouse Produce in England and Wales.*

Description.	Production.		Value.	
	1924-25.	1930-31.	1924-25.	1930-31.
Fruit and Vegetables—				
Tomatoes	47,000 tons	54,000 tons	£2,350,000	£2,190,000
Cucumbers	50 millions	54 millions	750,000	770,000
Grapes	1,500,000 lbs.	1,150,000 lbs.	130,000	90,000
Other descriptions ..	—	—	250,000	230,000
Total ..	—	—	3,480,000	3,280,000
Flowers, Foliage and Plants	—	—	1,350,000	2,070,000
Grand Total ..	—	—	4,830,000	5,350,000

The selling value of fruit and vegetables comprised 61 per cent. of the total value of all glasshouse produce in 1930-31. Of the remaining 39 per cent., flowers alone account for about three-fourths, the principal kinds on the basis of the returns received being chrysanthemums £390,000, roses £270,000, carnations £250,000 and tulips £150,000.

Scotland

The area under glasshouses in Scotland in 1930-31 is estimated by the Department of Agriculture for Scotland at 200 acres, as compared with 70 to 80 acres in 1924-25, the greater part of this area being used for tomato growing. The total output of tomatoes is estimated at 3,000 tons as against 2,000 tons.

The estimated value of all crops grown under glass in 1930-31 is £237,000 as compared with £120,000 in 1924-25. Details are given in Table II.

TABLE II.—*Value of Glasshouse Produce in Scotland.*

Description.	1924-25.	1930-31.
Tomatoes	£ 100,000	£ 160,000
Cucumbers	} 20,000 }	1,000
Grapes		3,200
Peaches		800
Flowers		26,000
Pot Bedding Plants		40,000
Other descriptions and mixed		6,000
Total	120,000	237,000

Imports of tomatoes into the United Kingdom in 1931 totalled about 147,000 tons as compared with 124,000 tons in 1925, and imports of grapes amounted to 944,000 cwts. No figures are available in respect of imports of cucumbers, but exports to this country from the Netherlands, whence the bulk of the imported supplies are received, amounted in 1931 to 2,750 tons gross weight. Imports of cut flowers in 1931 were valued at £1,064,000, as against £410,000 in 1925. These figures of imports include all produce, whether grown under glass or in the open; more detailed information will be found in the separate articles dealing with imports of tomatoes, grapes, cut flowers and miscellaneous vegetables respectively, which appear elsewhere in this publication.

IMPORTS OF RAW FRUIT

Imports of raw fruit in 1932 failed to reach the record high level of 1931, but only by a comparatively narrow margin; they were substantially heavier than in any previous year. The aggregate of just over 28 million cwts. (excluding nuts) shows a decline of less than 3 per cent. as compared with 1931, mainly due to lighter imports of citrus fruit and of soft fruits from the Continent. The declared value of the imports amounted to £27,515,000, a decline of 13 per cent. by comparison with 1931, and a lower figure than in any year since 1922, when the quantity imported was, of course, very much smaller.

Table I shows the total quantities of raw fruit imported into the United Kingdom in 1932 and the five preceding years.

TABLE I.—*Imports of Raw Fruit into the United Kingdom, 1927-32.*

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apples	6,161	6,089	5,758	6,172	7,599	8,120
Apricots	130	73	109	111	89	111
Bananas	(a)12,696	(a)12,966	(a)14,937	(a)14,990	(a)16,162	(a)17,123
Cherries	125	80	144	60	59	12
Currants	128	109	141	123	103	47
Gooseberries ..	57	32	16	29	17	11
Grapefruit ..	379	473	543	556	896	781
Grapes	718	839	864	695	944	905
Lemons	1,243	1,128	1,361	1,477	1,409	1,448
Limes and unspecified Citrus.	1	1	5	1	(d)	1
Oranges	7,898	7,761	9,264	10,207	10,391	9,350
Peaches	37	31	37	51	94	100
Pears	1,078	860	1,078	1,029	1,237	1,113
Pineapples ..	(c)	45	56	58	67	68
Plums	597	480	505	389	513	344
Strawberries ..	71	79	80	68	90	41
Other fruits ..	356	411	376	381	416	387
Total Imports ..	(b) 22,833	(b) 22,427	(b) 24,871	(b) 25,958	(b) 28,832	(b) 28,037

(a) Thousand bunches. (b) Including bananas estimated at 34 lbs. of fruit per bunch. (c) Included in "Other fruits." (d) Less than 500 cwts.

Table II shows the total values of raw fruit imported into the United Kingdom during the past six years.

TABLE II.—*Value of Imports of Raw Fruit, 1927–32.*

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	£000.	£000.	£000.	£000.	£000.	£000.
Apples	7,272	7,838	7,062	7,552	7,879	7,936
Apricots	291	221	306	322	243	171
Bananas	5,750	5,612	5,646	5,664	5,539	4,408
Cherries	276	172	316	132	149	40
Currants	324	275	355	262	227	120
Gooseberries	47	28	12	20	12	8
Grapefruit	667	791	902	903	1,234	1,117
Grapes	1,937	2,018	2,018	1,842	1,886	1,563
Lemons	1,186	1,251	1,423	1,414	1,256	1,357
Limes and unspecified Citrus	1	1	5	2	(b)	1
Oranges	8,593	7,898	9,806	9,548	9,548	7,677
Peaches	169	125	177	199	258	320
Pears	1,460	1,428	1,666	1,723	1,759	1,521
Pineapples	(a)	90	138	131	134	127
Plums	1,079	906	1,043	790	921	651
Strawberries	209	201	253	191	219	91
Other fruits	469	469	462	402	412	407
Total	29,730	29,324	31,590	31,097	31,676	27,515

(a) Included in "Other fruits."

(b) Less than £500.

In spite of the decline in fresh fruit imports as a whole there was no interruption last year in the steady upward trend of imports of bananas, peaches and pineapples, which each rose to a record height. Increasing quantities of bananas have reached this country annually since 1927, and imports in 1932 showed a further increase of a million bunches over the preceding year, the total amounting to over 17 million bunches. Imports of peaches totalled about 100,000 cwts., as compared with 94,000 cwts. in 1931, while pineapples, at 68,000 cwts., just exceeded the previous year's figure. Heavy quantities of apples were imported during 1932, the aggregate of 8,120,000 cwts. being considerably larger than in any year since 1926, and only failing by 164,000 cwts. to equal the record then established.

Imports of pears, at 1,113,000 cwts., and grapes, at 905,000 cwts. were lower than in 1931, but were higher than in each of the four years previous to that. A decline occurred in imports of oranges, the total of 9,350,000 cwts. being about a million cwts. lower than in each of the two preceding years. Imports of grapefruit also fell by comparison with 1931; this is the only year, since imports of this fruit were first separately recorded in 1920, that an increase has not been shown. Imports of lemons were heavier than in the previous year, but were just short of the record total reached in 1930. Imports of cherries, currants, gooseberries and strawberries fell to the lowest level in post-war years, while smaller imports of plums were recorded than in any year since 1922. On the other hand imports of apricots were above average.

In Table III are shown average declared values of each fruit imported during the past six years.

TABLE III.—Average Value per cwt. of Imports of Raw Fruit into the United Kingdom, 1927–32.

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
Apples	23 7	25 9	24 6	24 6	20 9	19 7
Apricots	44 11	60 6	55 10	58 0	54 9	30 9
Bananas	(a) 9 1	(a) 8 8	(a) 7 7	(a) 7 6	(a) 6 11	(a) 5 2
Cherries	44 2	43 3	43 11	44 4	50 9	65 6
Currants	50 7	50 5	50 3	42 9	44 0	51 5
Gooseberries ..	16 6	17 10	16 1	13 9	14 0	15 4
Grapefruit ..	35 3	33 6	33 3	32 6	27 6	28 9
Grapes	53 11	48 1	46 9	53 0	40 0	34 6
Lemons	19 1	22 2	20 11	19 2	17 11	18 9
Oranges	21 9	20 4	21 2	18 8	18 4	16 5
Peaches	89 11	81 5	96 11	77 5	54 10	64 0
Pears	27 1	33 2	30 11	33 6	28 5	27 4
Pineapples ..	(c)	39 9	49 6	45 9	40 3	37 5
Plums	36 2	37 9	41 4	40 7	35 11	38 0
Strawberries ..	58 6	51 1	63 1	56 6	49 6	44 9
Other fruits ..	26 4	22 10	24 6	21 1	19 9	21 0
All raw fruits ..	(b) 26 0	(b) 26 2	(b) 25 4	(b) 24 0	(b) 22 0	(b) 19 8

(a) Average value per bunch. (b) Including bananas estimated at 34 lbs. of fruit per bunch. (c) Included in "Other fruits."

Average declared values per cwt. in 1932, showed rises and falls in about equal proportions for the various fruits, but for the principal fruits imported such as apples, pears, oranges and bananas declines were general, so that the average value per cwt. for all fruit imported fell to a new low record for post-war years. Between 1928 and 1932 the average declared value of apples fell by 24 per cent., of bananas by 40 per cent., of grapes by 28 per cent., of oranges by 20 per cent., of pears by 18 per cent. and of lemons by 15 per cent. Changes in average values are in a large measure due to changes in the relative proportions of fruit imported from various countries, as well as to the volume of supplies available on the market. Both home production and imports of apples in 1932 were substantially heavier than in 1931. The pronounced rise in the average value of cherries may be attributed to the scarcity of that fruit in 1932, while the rises in the cases of peaches and plums may be accounted for by the larger proportion of South African and the smaller proportion of continental fruit imported in 1932 as compared with 1931. To the heavier supplies of Spanish grapes in 1932 may be attributed the fall in the declared value of this fruit as compared with the previous year.

Table IV shows re-exports of fruit from the United Kingdom in each of the past six years.

TABLE IV.—*Re-exports of certain Imported Fruits, 1927-32.*

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apples	371	346	258	350	310	343
Bananas	(a) 381	(a) 515	(a) 656	(a) 615	(a) 494	(a) 300
Grapefruit ..	8	14	16	23	30	21
Grapes	36	35	40	29	30	21
Lemons	36	34	62	43	48	39
Oranges	255	272	308	615	426	332
Peaches	2	1	3	5	5	6
Pears	20	31	37	89	80	80
Pineapples ..	(c)	7	10	9	12	4
Plums	7	6	9	11	17	12
Other fruits ..	12	10	10	8	10	5
Total	(b) 863	(b) 912	(b) 952	(b) 1,369	(b) 1,118	(b) 954

(a) Thousand Bunches. (b) Including bananas at 34 lbs. of fruit per bunch.

(c) Included in "Other fruits."

Re-exports of fruit constitute only an inconsiderable proportion of total imports into the United Kingdom, but in the aggregate the volume of such exports is fairly important, especially for apples, bananas and oranges.

EMPIRE FRUIT IMPORTS

A new record was created in 1932 in imports into the United Kingdom of fresh fruit from Empire sources, which amounted to nearly 10,600,000 cwts. This compares with 8,100,000 cwts. in the previous year and 8,600,000 cwts. in 1930. A record was also established in imports from Empire countries of the following separate fruits:—apples, bananas, grapefruit, grapes, oranges, peaches and plums.

In Table I are shown aggregate imports into the United Kingdom of each kind of fruit from Empire countries in 1932 and the previous five years.

TABLE I.—Imports of Raw Fruit consigned from British Countries.

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apples	1,936	3,035	2,326	3,823	3,153	3,897
Apricots	(a)	(a)	(a)	1	(a)	(a)
Bananas	(b) 1,971	(b) 2,741	(b) 4,015	(b) 5,924	(b) 6,979	(b) 10,610
Cherries	—	(a)	(a)	(a)	—	(a)
Currants	(a)	(a)	(a)	(a)	(a)	(a)
Gooseberries ..	(a)	(a)	1	(a)	(a)	1
Grapefruit	52	55	75	90	138	231
Grapes	77	62	71	80	87	93
Lemons	5	3	18	4	9	18
Limes and unspeci- fied Citrus	(a)	1	5	1	(a)	1
Oranges	1,952	1,673	1,483	2,427	2,269	2,727
Peaches	23	14	20	26	20	30
Pears	110	240	120	322	251	301
Plums	31	35	25	36	46	52
Strawberries ..	(a)	(a)	1	(a)	—	(a)
Pineapples	} 36 {	7	11	6	4	8
Other fruits		19	26	13	16	17
Total	(c) 4,820	(c) 5,975	(c) 5,395	(c) 8,627	(c) 8,113	(c) 10,597

(a) Less than 500 cwts.

(b) Thousand bunches.

(c) Including bananas estimated at 34 lbs. of fruit per bunch.

Empire imports in 1932 represented 37·7 per cent. of aggregate imports of fruit from all sources. This is a larger proportion than ever before, and compares with 28·1 per cent. in the previous year and 33·2 per cent. in 1930.

Table II shows for each kind of fruit the proportion of total imports that was accounted for by imports from Empire countries.

TABLE II.—*Imports of Raw Fruit: Proportion consigned from British Countries.*

Description of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Apples	31·4	49·9	40·4	61·9	41·5	48·0
Apricots	0·4	0·6	0·4	0·7	0·5	0·4
Bananas	15·5	21·1	26·1	39·5	43·2	61·4
Cherries	—	(a)	(a)	(a)	—	0·5
Currants	(a)	0·1	0·2	(a)	(a)	0·1
Gooseberries ..	0·4	1·4	5·0	1·2	1·6	5·5
Grapefruit ..	13·8	11·6	13·8	15·8	15·4	29·6
Grapes	10·8	7·4	8·2	11·5	9·2	10·3
Lemons	0·4	0·2	1·3	0·3	0·7	1·2
Limes and unspeci- fied Citrus ..	48·0	95·0	99·5	97·3	77·1	98·0
Oranges	24·7	21·6	16·0	23·7	21·8	29·1
Peaches	61·0	45·3	53·0	51·3	21·1	29·9
Pears	10·2	27·9	11·1	31·4	20·3	27·1
Plums	5·2	7·4	5·0	9·3	9·0	15·2
Strawberries ..	(a)	0·1	0·9	(a)	—	(a)
Pineapples ..	10·2	15·1	19·5	9·9	6·5	11·8
Other fruits ..		4·7	7·0	3·3	3·9	4·3
Total	21·1	26·7	21·7	33·2	28·1	37·7

(a) Less than 0·05 per cent.

Apples.—A larger quantity of apples reached the United Kingdom from Empire countries in 1932 than ever before, mainly on account of record imports from Australia and New Zealand, the total amounting to nearly 3,900,000 cwts. Empire imports accounted for 48 per cent. of aggregate imports from all sources, as against 41·5 per cent. in 1931. In 1930, however, the proportion was as high as 61·9 per cent. owing to unusually light imports from foreign countries in that year.

Bananas.—Imports of bananas from Empire countries (almost all from Jamaica) have been rising steadily each year since 1927, and reached the unprecedented total of 10,600,000 bunches in 1932. Imports of bananas from foreign sources declined during 1932 and the Empire accounted for no less than 61·4 per cent. of total imports as compared with 43·2 per cent. in 1931.

Grapefruit.—Although aggregate imports of grapefruit declined in 1932, a record quantity, some 231,000 cwts., was imported from Empire countries. A new high level was reached in imports from South Africa, the British West Indies and Palestine, and Empire imports accounted for nearly 30 per cent. of the total, as compared with 15 per cent. in 1931.

Grapes.—Only a comparatively small proportion of the imports of grapes into the United Kingdom come from Empire sources, but Empire supplies are increasing, and in 1932 a larger quantity came from Empire countries than in any previous year, mainly on account of record imports from South Africa. The Empire total of 93,000 cwts. represented 10·3 per cent. of aggregate imports from all sources, a larger proportion than in 1931, but smaller than in 1930, when imports from foreign countries were considerably below normal.

Lemons.—The Empire supplies only a very small part of the lemons reaching the United Kingdom, but imports from Empire countries in 1932 rose to 18,000 cwts. ; this is 1·2 per cent. of total imports from all sources.

Limes.—The bulk of the imports specified as limes and other citrus fruit came from Empire sources in 1932, and consisted of limes from the British West Indies and the Gold Coast, but imports of this fruit are of minor importance.

Oranges.—Imports of oranges from Empire sources in 1932 reached a record total of over 2,700,000 cwts. Supplies from South Africa and Southern Rhodesia fell just short of the 1930 total, but were heavier than in any other year, while imports from Palestine reached a new high level. The proportion of aggregate imports of oranges, which came from Empire countries, also established a record of 29·1 per cent.

Peaches.—A larger quantity of peaches was imported from the Empire in 1932 than in any previous year, the total amounting to some 30,000 cwts., almost all from South Africa. This represented about 29·9 per cent. of aggregate imports of peaches, as against 21·1

per cent. in 1931, but the proportion is considerably less than in 1930 and earlier years, owing to the increase in imports of peaches from foreign countries in 1931 and 1932.

Pears.—Imports of pears from Empire sources amounted to about 301,000 cwts. in 1932 or 21,000 cwts. less than the record total reached in 1930, but more than in any other year. Imports from Canada, Australia and South Africa declined from the high levels of 1930, but a record quantity was imported from New Zealand. Empire pears accounted for 27·1 per cent. of imports from all sources during the year.

Plums.—Heavier supplies of plums were imported from Empire countries in 1932 than in any previous year, mainly on account of the record quantity from South Africa, the total amounting to about 52,000 cwts., representing 15·2 per cent. of aggregate imports from all sources.

FRUIT CONSUMPTION IN THE UNITED KINGDOM.

The figures of home production of fruit and of imports and re-exports given on pages 14–16, 20 and 23, supply material for approximate calculations of the total quantity of raw fruit available for consumption in the United Kingdom from year to year. In Scotland and Northern Ireland official estimates of fruit production are only made every fifth year, and in other years it is necessary to include approximate figures in these calculations, but the quantity of fruit produced in these countries is normally small as compared with the production in England and Wales, and smaller still by comparison with total fruit imports. Thus no significant error is likely to arise from assuming Scotland's and Northern Ireland's output from 1925 to 1929 at the 1925 volume. A further allowance must be made for the carry-over of fruit from one year to another; no information is available as to the carry-over of imported fruit, but the Ministry of Agriculture and Fisheries estimates that on the average some 16 per cent. of the home apple crop is marketed after the end of December, and a net addition or deduction has to be made accordingly to represent fruit grown, but not consumed, in the calendar year.

Furthermore, although cider apples and perry pears are excluded from all calculations, no similar adjustment is possible for imported apples, although some part of the apples imported consist of cider fruit, but again the error is not likely to be of importance.

The results of the calculations during the past seven years are shown in the following table :—

TABLE I.—*Fresh Fruit Supplies and Consumption.*

	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Net imports (a)	24,409	21,967	21,515	23,919	24,589	27,714	27,083
Home production less exports (b)	4,820	9,590	5,875	10,020	9,862	4,862	5,805
Add or deduct to allow for carry-over of apples	+863	-773	+488	-561	+395	+379	-150
Net supplies	30,092	30,784	27,878	33,378	34,846	32,955	32,738
Consumption per head	lbs. 74·5	lbs. 75·9	lbs. 68·5	lbs. 81·8	lbs. 85·0	lbs. 80·1	lbs. 79·1

(a) Excluding nuts, but including bananas at 34 lbs. of fruit per bunch.

(b) Excluding cider apples and perry pears.

According to these figures the decline from the high level of fruit consumption in 1930, which was recorded in 1931, continued in 1932, but on a much smaller scale, the apparent consumption per head being estimated at approximately 85 lbs. in 1930, 80 lbs. in 1931 and 79 lbs. in 1932. Last year's total is, however, considerably higher than in any year previous to 1929. The figures of course include fruit used for all purposes, not only for household consumption, but also for preserving, and they take no account of consumption of imported canned and dried fruits and of fruit pulp used for jam making, imports of which have also tended to increase in recent years.

The estimated quantity of each kind of raw fruit available per head of the population in each of the past seven years is given in Table II. The figures have been arrived at on the same basis as the *per caput* consumption figures in Table I (home production and imports, less exports and re-exports, with an adjustment for carry-over of the home apple crop).

TABLE II.—*Estimated Quantity of Raw Fruit available per head of Population, 1926-32.*

Description of Fruit.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Apples	24.4	27.0	22.5	27.8	26.1	22.5	25.4
Bananas	9.9	9.2	9.3	10.6	10.6	11.5	12.3
Cherries	1.0	1.1	0.7	1.1	1.3	0.8	0.7
Currants	0.9	1.1	0.9	1.2	1.2	1.0	0.7
Gooseberries ..	1.8	1.8	1.6	1.7	2.2	1.7	1.3
Grapefruit ..	0.5	0.9	1.1	1.3	1.3	2.1	1.8
Grapes	1.2	1.7	2.0	2.0	1.6	2.3	2.1
Lemons & Limes	3.2	3.0	2.7	3.2	3.5	3.3	3.4
Oranges	19.2	18.8	18.4	21.9	23.4	24.2	21.8
Pears	4.4	4.3	2.8	3.8	3.2	3.4	3.1
Plums	4.3	3.9	3.5	4.2	7.1	2.8	2.5
Raspberries ..	0.5	0.5	0.4	0.5	0.8	0.8	0.8
Strawberries ..	1.9	1.3	1.3	1.2	1.3	2.1	1.8
Other fruits ..	1.3	1.3	1.3	1.3	1.4	1.6	1.4
Total	74.5	75.9	68.5	81.8	85.0	80.1	79.1

Of the fruits grown in this country it may be said that apparent consumption is influenced far more by the volume of the home output than by imports. When crops are light imports may be increased, but not to a sufficient extent to make up the deficiency as compared with a good crop; similarly, when crops are heavy imports are likely to be reduced, but by a much smaller proportion. Moreover, a very heavy home crop may lead to some part of the output being unsaleable, and consequently left ungathered, and to the extent that such waste occurs the consumption figures given above may be exaggerated, as for example, in the case of apples in 1927 and 1929 and plums and gooseberries in 1930, appreciable quantities of which were reported to have been left on the trees and bushes.

In 1932 the decline in consumption by comparison with the preceding year was due to decreased supplies of oranges, grapefruit, pears and a number of other fruits, but the upward trend in the consumption of bananas continued. Supplies of apples were heavier than in 1931, but did not equal the quantities available in 1929 and 1930.

IMPORTS OF APPLES

Imports of apples in 1932 continued the upward movement begun in 1930 after the slight set back of the previous year, and the total of 8,120,000 cwts. fell short by only 164,000 cwts. of the record imports in 1926. But imports from Empire countries were higher than ever before, mainly due to record Australian and New Zealand supplies. The Empire accounted for 48 per cent. of aggregate imports as against 41·5 per cent. in 1931. In 1930, however, the proportion was nearly 62 per cent. owing to unusually light foreign supplies in that year. Table I shows imports during the past six years.

TABLE I.—*Imports of Apples into the United Kingdom, 1927-32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Canada	1,185	1,247	1,707	2,086	1,769	1,612
Australia	557	1,442	352	1,351	1,033	1,684
New Zealand	187	342	258	380	337	573
South Africa	2	1	3	3	11	13
Other Empire Countries	5	3	6	3	3	15
United States	3,825	2,955	3,089	2,235	3,534	3,157
France	128	34	95	65	657	617
Belgium	104	25	59	3	69	330
Netherlands	30	4	68	6	83	47
Russia	28	24	20	10	5	17
Portugal	88	5	66	14	40	7
Italy	15	4	18	(a)	5	5
Germany	1	3	10	10	41	33
Other Foreign Countries	6	(a)	7	5	12	10
Total Empire Countries	1,936	3,035	2,326	3,823	3,153	3,897
Total Foreign Countries	4,225	3,054	3,432	2,348	4,446	4,223
Total	6,161	6,089	5,758	6,172	7,599	8,120

(a) Less than 500 cwts.

Not only were shipments of apples to Europe in 1932 from both Australia and New Zealand higher than in any previous year, but a larger proportion of the total was shipped to the United Kingdom

than in the 1931 season. The United Kingdom took 90 per cent. of the total combined shipments to Europe in 1932, as against 75 per cent. of the smaller 1931 total. Imports from Australia showed an increase of 64 per cent. over 1931 and imports from New Zealand a rise of 70 per cent.

Imports from Canada in the early months of 1932 were rather heavier than in the corresponding months of the previous year, following the good crop of 1931, but the decline in the 1932 Canadian crop, particularly in Nova Scotia, had its effect on imports in the closing months of that year. Total imports from Canada in 1932 were lighter, by about 9 per cent., than in the previous year.

There was a further slight advance in imports from South Africa following the sharp rise in the previous year. The Channel Islands and the Irish Free State accounted for the balance of the imports from Empire sources.

In Table II are shown imports in each month during the past six years.

TABLE II.—*Imports of Apples into the United Kingdom in each Month, 1927–32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	682	453	720	609	531	496
February	851	443	667	487	419	740
March	755	401	435	506	385	613
April	506	346	521	422	481	397
May	450	504	435	474	466	744
June	332	522	229	554	596	1,079
July	203	413	167	457	303	227
August	121	279	117	145	121	129
September	345	371	241	160	554	757
October	566	1,024	673	900	1,336	1,418
November	755	845	909	761	1,464	947
December	595	488	644	697	943	573
Total	6,161	6,089	5,758	6,172	7,599	8,120

Heavy imports from the United States were recorded in the early months of 1932 following the large 1931 crop, but in the closing months of the year imports were on a lighter scale than in the corresponding months of 1931. The result was a drop in total imports in 1932 of over 10 per cent. from the previous year's high level.

Apple crops in most European countries in 1932 were only moderate, but exceptionally high yields in a few important regions, such as Styria and Carinthia in Austria and the Italian Tyrol counterbalanced to a very large extent the shortage in other parts, and there were large movements of supplies from those districts to Germany and other European countries. France and Belgium furnished the bulk of the imports into the United Kingdom in 1932 from European countries and a very large proportion of those imports consisted of cider fruit. Thus for the second year in succession imports from Europe were on an exceptionally heavy scale, owing to the poor yield in each year of cider fruit in England and Wales.

Excepting in the brief intervals of relatively low supplies which occurred at the close of the North American and at the close of the Australia-New Zealand seasons, imports throughout 1932 were maintained at an exceptionally high level, a declining tendency being evident only at the very end of the year. Imports during May and June, when Australian and New Zealand supplies are at their height were larger than ever previously recorded in those months. The heavy imports in September and October, as in the previous year, included substantial imports of cider fruit from the Continent. Table III shows imports from each of the chief countries of consignment in 1932.

TABLE III.—*Imports of Apples into the United Kingdom in each Month of 1932, showing the Principal Countries whence Consigned.*

Month.	Canada.	Australia.	New Zealand.	United States.	France.	Other countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	132	—	—	326	22	16	496
February	133	—	—	597	4	6	740
March ..	57	1	11	531	—	13	613
April ..	3	188	65	137	—	4	397
May ..	—	542	168	32	—	2	744
June ..	—	778	286	8	1	6	1,079
July ..	—	175	40	7	1	4	227
August ..	7	—	3	64	—	55	129
September	152	—	—	274	141	190	757
October ..	436	—	—	503	324	155	1,418
November	367	—	—	490	71	19	947
December	325	—	—	188	53	7	573
Total ..	1,612	1,684	573	3,157	617	477	8,120

IMPORTS OF APRICOTS

There was a substantial recovery in imports of apricots in 1932 from the comparatively low figure to which they had declined in the previous year, and this was entirely due to the unusually large supplies from Spain. Imports from that country reached a new high level and accounted for more than 95 per cent. of the total imports. On the other hand, supplies from France again fell sharply and were the smallest recorded since 1919, when imports of peaches and apricots combined amounted to only 600 cwts.

The change which has occurred in the country of consignment of raw apricots since the war is very striking. In 1921 France accounted for 33,000 cwts. out of a total of 34,000 cwts. imported; after that for several years the two countries were on fairly level terms; but since 1927 Spain has definitely gone ahead.

Imports from South Africa are still very small in comparison with those from the main sources of supply, although on account of the difference in the seasons they do not suffer any competition from these other sources.

Table I shows imports during the past six years.

TABLE I.—Imports of Apricots into the United Kingdom, 1927–32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
South Africa	251	362	253	246	487	452
Australia	155	40	138	520	—	—
Other Empire Countries..	52	1	—	—	—	—
Spain	92,564	55,961	80,624	82,849	78,401	107,418
France	36,379	15,886	23,430	26,312	8,483	2,840
Other Foreign Countries..	110	699	5,026	1,022	1,190	574
Total Empire Countries	458	403	391	766	487	452
Total Foreign Countries	129,053	72,546	109,080	110,183	88,074	110,832
Total	129,511	72,949	109,471	110,949	88,561	111,284

Table II shows imports of apricots by months during the past six years.

TABLE II.—Imports of Apricots into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	176	363	83	194	360	98
February	8	1	6	—	4	—
March	—	1	—	—	—	—
April	—	—	8	—	—	—
May	13,121	9,789	1,090	4,306	15,304	13,451
June	80,164	50,866	49,496	77,764	64,300	69,736
July	35,746	11,474	56,187	28,630	8,307	27,074
August	—	410	2,437	3	163	571
September	177	—	—	—	—	—
October	—	—	—	—	—	—
November	1	5	—	—	—	—
December	118	40	164	52	123	354
Total	129,511	72,949	109,471	110,949	88,561	111,284

Imports of raw apricots from the Continent begin towards the end of May, but June and July see the bulk of the imports. Generally, the greater proportion of imported supplies arrives in June, but in years when the season is late, as for example in 1929, the peak of the season is naturally delayed, and July imports may approach or even exceed those of June.

The South African raw apricot supplies arrive during December and January, but the trade shows little development. In contrast with the steady growth in imports of other fruits from South Africa during the winter months, the demand for fresh apricots is apparently not sufficient to encourage larger consignments.

There is little difference in the seasons of the two chief continental shippers of fresh apricots, the imports from France and Spain showing much the same variations between the different months. Table III shows imports by months for 1932, separating the figures for the principal countries of consignment. But the table should be read in conjunction with that showing imports of apricot pulp in 1932, given on page 75. Imports of apricot pulp come almost entirely from Spain, and the season is at its height in July, August and September, although, unlike raw apricots, apricot pulp is shipped throughout the year.

The Murcia (Spanish) crop was abundant in 1932 but was harvested under unfavourable weather conditions.

The Perpignan (French) crop was reported to be good, although it suffered some damage from a fall of snow in May ; the heavy decline in imports from France was evidently due to causes other than the size of the crop.

TABLE III.—*Imports of Apricots during each Month of 1932, showing Countries whence consigned.*

Month.	South Africa.	Spain.	France.	Other countries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.
January.. ..	98	—	—	—	98
February	—	—	—	—	—
March	—	—	—	—	—
April	—	—	—	—	—
May	—	13,010	441	—	13,451
June	—	68,341	1,252	143	69,736
July	—	25,906	847	321	27,074
August	—	161	300	110	571
September .. .	—	—	—	—	—
October	—	—	—	—	—
November .. .	—	—	—	—	—
December .. .	354	—	—	—	354
Total	452	107,418	2,840	574	111,284

IMPORTS OF BANANAS

The very rapid development of the trade in bananas since the beginning of the century has raised imports from an average of 2,660,000 bunches in the five years 1900-04, and 6,710,000 bunches in the quinquennium immediately preceding the war, to the striking figures which are shown in Table I. The new high level attained in 1932 was nearly 1,000,000 bunches ahead of the previous record in 1931 and over 2,000,000 bunches higher than imports in 1929 and 1930.

The rapid increase in imports from Empire sources is the most striking feature of the figures in the table. Jamaica is practically the sole Empire source of supply of bananas to the United Kingdom market, and imports from that source last year showed the most striking increase yet recorded. The Empire's share of all imports rose from 43 per cent. in 1931 to 62 per cent. in 1932. Until 1930 the Empire share of banana imports had never reached 30 per cent. in any year, except 1918 and 1919 when imports were on a very restricted scale. This result may be attributed to two causes ; first the operations

of the Jamaica Banana Producers' Association and the arrangements for direct shipments to the United Kingdom market of bananas handled by that Association, and secondly the allocation of a larger proportion of Jamaica bananas to this country by other interests importing bananas, with a larger proportion of the Colombian and Central American supplies going to Europe and the United States.

TABLE I.—*Imports of Bananas into the United Kingdom, 1927-32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand bunches.	Thou- sand bunches.	Thou- sand bunches.	Thou- sand bunches.	Thou- sand bunches.	Thou- sand bunches.
British West Indies ..	1,971	2,741	4,015	5,924	6,971	10,609
Other Empire Countries..	(a)	(a)	(a)	1	8	1
Canary Islands	1,809	1,599	1,224	967	892	524
Honduras	2,645	1,572	2,916	985	2,700	2,938
Costa Rica	2,044	2,204	1,669	2,189	1,621	197
Colombia	3,771	3,957	3,748	3,352	1,675	585
Guatemala	—	—	—	—	163	533
Panama	—	—	2	10	594	140
Brazil	455	885	1,351	1,429	1,472	1,590
Other Foreign Countries..	1	8	12	133	66	6
Total Empire Countries	1,971	2,741	4,015	5,925	6,979	10,610
Total Foreign Countries	10,725	10,225	10,922	9,065	9,183	6,513
Total	12,696	12,966	14,937	14,990	16,162	17,123

(a) Less than 500 bunches.

Exports of bananas from Jamaica in 1932 totalled approximately 20,300,000 bunches, as compared with 22,300,000 bunches in the previous year and 24,800,000 in 1930. During the three years there has been a marked change in the distribution of the exports as between Europe and the United States of America. The quantity taken by the United States, which was about 12 million bunches in 1930, or nearly one-half of the total, fell to 10 million bunches in the following year, and to less than 4½ million bunches, or only 22 per cent. of the total, in 1932. Exports to Europe, which amounted to approximately 9 million bunches in 1930 and in 1931, rose to over 13 million bunches in 1932, and represented nearly two-thirds of the aggregate quantity exported. Canada took an average of just over 3 million bunches annually during the three years.

The following table shows the exports of bananas from Jamaica and the quantities handled by the various exporting agencies in the past three years, according to figures published in the "West India Committee Circular," which do not, however, show the allocation of exports to Europe as between the United Kingdom and the Continent.

TABLE II.—*Exports of Bananas from Jamaica.*

Destination.	United Fruit Company and Elders and Fyffes, Ltd.	Jamaica Banana Producers' Association.	Standard Fruit Company.	Other Companies.	Total.
<i>1930.</i>					
United States ..	Bunches. 3,623,595	Bunches. 3,416,670	Bunches. —	Bunches. 5,254,735	Bunches. 12,295,000
Canada	1,276,258	1,875,916	—	—	3,152,174
Europe	6,470,613	2,842,298	—	—	9,312,911
Total ..	11,370,466	8,134,884	—	5,254,735	24,760,085
<i>1931.</i>					
United States ..	3,387,892	2,475,169	1,892,212	2,101,234	9,856,507
Canada	1,521,914	1,803,418	271,444	—	3,596,776
Europe	5,492,710	3,358,226	—	—	8,850,936
Total ..	10,402,516	7,636,813	2,163,656	2,101,234	22,304,219
<i>1932.</i>					
United States ..	660,987	1,690,435	2,032,766	2,346	4,386,534
Canada	1,224,662	1,434,741	—	1,596	2,660,999
Europe	8,561,576	3,194,830	1,479,415	—	13,235,821
Total ..	10,447,225	6,320,006	3,512,181	3,942	20,283,354

Apart from the increase in imports from Jamaica, there have been other significant developments in the banana trade in recent years. The chief of these has been the rise in imports of bananas from Brazil. This trade started during the first half of 1927, and has developed rapidly, although the rate of expansion during the past few years has been much slower than in the first two years of the trade. As in the previous year, Brazil's proportion of total imports was about 9 per cent.

Imports from the Canary Islands have been declining steadily for several years past, and Canary bananas are more and more finding a market on the Continent, especially in Spain and France. In the space of six years imports of Canary bananas into the United Kingdom have fallen from over 2½ million to little more than half a million

bunches, and the total in 1932 was the smallest recorded in any year during the present century. Up to 1905 the Canary Islands were the chief source of supply of bananas for the British market, furnishing well over one-half of the total ; in 1932 the proportion of all imports obtained from the Canary Islands was only 3 per cent.

The group of countries in Central and South America which account for the balance of the imports have undergone drastic changes in recent years in respect of their individual contributions. Imports from Honduras made a complete recovery from the set-back which occurred in 1930 and in 1932 were the heaviest yet recorded from that country. On the other hand the drastic decline in imports from Costa Rica and Colombia have been to only a slight extent made up by imports from recent new-comers, Guatemala and Panama. Combined imports from this group which furnished 40 per cent. of total imports in 1931 accounted for little more than 25 per cent. in 1932, and Honduras alone was responsible for 17 per cent.

The change in the sources of Britain's banana imports during the present century are clearly shown in the following table. The change in the countries constituting the United Kingdom in 1923 has no important bearing upon the figures, as the Irish Free State obtains practically the whole of its imports from the United Kingdom.

TABLE III.—*Imports of Bananas into the United Kingdom, 1900–32.*

Period.	British West Indies.		Colombia and Central America.		Canary Islands.		Brazil.		Total Imports*
	Thou- sand bunches	Per cent. of total.	Thou- sand bunches	Per cent. of total.	Thou- sand bunches	Per cent. of total.	Thou- sand bunches	Per cent. of total.	Thou- sand bunches
<i>Quinquennial average:</i>									
1900–04 ..	535	20·1	361	13·6	1,767	66·3	—	—	2,664
1909–13 ..	584	8·7	4,186	62·3	1,932	28·8	—	—	6,713
1922–26 ..	2,459	20·6	6,959	58·4	2,500	21·0	—	—	11,918
<i>Year.</i>									
1927 ..	1,971	15·5	8,460	66·6	1,809	14·3	455	3·6	12,696
1928 ..	2,741	21·2	7,733	59·7	1,599	12·3	885	6·8	12,966
1929 ..	4,015	26·9	8,333	55·8	1,224	8·2	1,351	9·0	14,937
1930 ..	5,924	39·5	6,526	43·6	967	6·4	1,429	9·4	14,990
1931 ..	6,971	43·1	6,753	41·8	892	5·5	1,472	9·0	16,162
1932 ..	10,609	62·0	4,393	25·6	524	3·1	1,590	9·3	17,123

* Including small quantities from other sources.

Imports of bananas are registered throughout the year, although imports during the summer months are rather heavier than during the winter. The peak of imports is usually in July, and the six months

May to October consistently account for approximately 60 per cent. of the annual imports. Figures of monthly imports during the past six years are shown in Table IV.

TABLE IV.—*Imports of Bananas into the United Kingdom in each Month, 1927–32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.
January	850	972	933	886	1,026	1,034
February	771	670	667	883	1,035	1,119
March	910	961	872	1,026	948	1,378
April	924	1,040	988	1,147	1,176	1,324
May	959	1,174	1,423	1,384	1,348	1,654
June	1,110	1,403	1,354	1,477	1,643	1,422
July	1,414	1,201	1,550	1,737	1,820	2,130
August	1,114	1,494	1,876	1,478	1,480	1,650
September	1,357	1,250	1,482	1,415	1,673	1,946
October	1,205	1,223	1,528	1,682	1,603	1,440
November	1,006	977	1,336	943	1,265	1,206
December	1,076	601	928	932	1,145	820
Total	12,696	12,966	14,937	14,990	16,162	17,123

In Table V are shown imports of bananas during each month of 1932 from the principal sources of supply.

TABLE V.—*Imports of Bananas in each month of 1932, showing Countries whence Consigned.*

Month.	British West Indies.	Canary Islands.	Honduras.	Guatemala.	Colombia.	Brazil.	Other Countries.	Total.
	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.
January	347	32	69	23	271	134	158	1,034
February	636	21	78	—	31	173	180	1,119
March	834	41	267	—	21	214	1	1,378
April	974	15	141	—	12	182	—	1,324
May	846	28	578	28	75	99	—	1,654
June	659	106	388	112	—	156	1	1,422
July	934	114	626	263	10	182	1	2,130
August	1,206	39	297	—	33	73	2	1,650
September	1,571	76	121	22	40	116	—	1,946
October	1,216	27	46	—	66	84	1	1,440
November	1,007	11	58	12	26	92	—	1,206
December	379	14	269	73	—	85	—	820
Total	10,609	524	2,938	533	585	1,590	344	17,123

IMPORTS OF CHERRIES

Imports of cherries in 1932 declined by 80 per cent. as compared with 1931 and were the lowest recorded in post-war years. The heavy decline was to a very large extent due to the comparatively negligible supplies from France, which fell to under 300 cwts. after averaging about 36,000 cwts. during the previous five years, but imports from Belgium, which has been the principal source of supply since the introduction of the Cherry Fruit Fly Order, were less than one quarter of the previous years imports, while imports from Holland were also lower. Italian supplies showed an increase over 1931.

No imports were recorded from Germany and only negligible quantity from Spain. The small total from Empire Countries was imported from Canada and the Irish Free State. Table I shows imports during the past six years.

TABLE I.—*Imports of Cherries into the United Kingdom, 1927-32.*

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Germany	157	10,969	1,098	493	1,965	—
Netherlands	5,153	6,074	13,263	6,694	3,542	2,000
Belgium	36,702	44,921	66,116	30,914	28,796	6,619
France	72,501	15,575	55,220	16,697	19,822	299
Spain	37	210	—	—	1,342	19
Italy	10,359	1,906	8,091	4,677	2,779	3,090
Other Foreign Countries..	—	—	—	36	287	4
Total Foreign Countries..	124,909	79,655	143,788	59,510	58,533	12,031
Total Empire Countries..	—	2	19	1	—	61
Total	124,909	79,657	143,807	59,511	58,533	12,092

The 1932 season was somewhat late and the peak of imports occurred in July, whereas in the previous year and in 1930 the peak occurred a month earlier. Table II shows imports by months during each of the past six years.

TABLE II.—Imports of Cherries into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
May	11,895	5,202	10,680	6,703	7,400	94
June	69,299	18,033	54,735	29,393	27,285	4,451
July	42,432	41,420	60,221	23,126	22,466	5,574
August	1,280	12,116	17,669	289	1,382	1,973
September	—	2,886	483	—	—	—
October	3	—	—	—	—	—
November.. .. .	—	—	—	—	—	—
December.. .. .	—	—	19	—	—	—
Total	124,909	79,657	143,807	59,511	58,533	12,092

The final table shows imports in 1932 by months from each of the chief countries of supply. France and Italy normally start exporting in May, with the peak of shipments in June, while Belgium and Holland commence in June, with the peak occurring early in July. The seasonality of supplies is, however, affected by the embargo on imports from France and Italy after certain dates (varying with the districts), which tends to advance the peak of the season of importation from these countries.

TABLE III.—Imports of Cherries in each Month of 1932, showing Countries whence consigned.

Month.	France.	Belgium.	Nether-lands.	Italy.	Other Countries	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
May	94	—	—	—	—	94
June	205	1,137	—	3,090	19	4,451
July	—	3,881	1,688	—	5	5,574
August	—	1,601	312	—	60	1,973
Total	299	6,619	2,000	3,090	84	12,092

IMPORTS OF RAW CURRANTS

The largest total of imports of raw currants ever recorded was in 1914, when the total reached 144,000 cwts. The post-war record of 1929 closely approached this figure, but the following years witnessed a decline, while total imports in 1932 dropped sharply to 45 per cent. of the previous year's imports and the lowest total recorded in post-war years.

France, Holland and Belgium have always accounted for the bulk of the imports of raw currants, and the order of importance has remained unchanged over a fairly long period, with France furnishing over one half the total.

In Table I are shown annual imports of raw currants in each of the past six years. British trade returns do not differentiate between black and red currants, but there is little doubt that the bulk of the imports consists of black currants.

TABLE I.—*Imports of Currants into the United Kingdom, 1927-32.*

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
France	86,106	66,680	99,577	72,123	62,670	37,537
Norway	3,442	5,561	3,066	2,095	1,839	3,147
Netherlands	26,811	21,512	20,570	28,770	24,968	3,407
Belgium	11,171	14,830	17,494	15,834	12,507	1,773
Spain	391	—	—	3,651	808	692
Other Foreign Countries	205	507	354	95	380	27
Total Foreign Countries..	128,126	109,090	141,061	122,568	103,172	46,583
Total Empire Countries..	51	114	234	46	31	36
Total ..	128,177	109,204	141,295	122,614	103,203	46,619

Imports from France in 1932 showed a substantial decline as compared with previous years, but with imports from the Netherlands and Belgium reduced to relatively unimportant proportions, French supplies accounted for over 80 per cent. of total imports. Imports from Norway which showed a recovery from the declines recorded in recent years, were little short of the quantity imported from Holland and were heavier than imports from Belgium. A rather

smaller quantity than in the previous year was imported from Spain. The almost negligible imports from Empire countries came mainly from the Irish Free State.

The season of importation of fresh currants is a short one, extending only from June to September, while the bulk of the imports are registered in July. The figures of imports by months over the past six years are shown in Table II.

TABLE II.—*Imports of Currants into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
May	—	2	102	46	—	—
June	50,150	19,956	21,511	10,710	17,485	4,182
July	67,319	78,875	106,707	104,311	80,590	38,252
August	10,128	10,164	12,975	7,547	4,038	4,016
September ..	580	207	—	—	1,090	169
Total ..	128,177	109,204	141,295	122,614	103,203	46,619

Normally about 80 per cent of the imports are recorded in July, and the bulk of the French, Dutch, Belgian and Spanish supplies arrive during that month, but August is the peak month for imports from Norway.

Table III shows monthly imports from the different countries in 1932.

TABLE III.—*Imports of Currants in each Month of 1932, showing Countries whence consigned.*

Month.	France.	Nether-lands.	Belgium.	Spain.	Norway.	Other Countries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
June	4,055	3	121	3	—	—	4,182
July	33,442	2,240	1,652	689	190	39	38,252
August	40	1,164	—	—	2,789	23	4,016
September ..	—	—	—	—	168	1	169
Total ..	37,537	3,407	1,773	692	3,147	63	46,619

In addition to the raw fruit, considerable quantities of black currant pulp are imported mainly from the Netherlands and France. In 1932, the imports of pulp, which, as shown on page 79, amounted to nearly 75,000 cwts., and of raw fruit combined amounted to over 120,000 cwts.

IMPORTS OF GOOSEBERRIES

Imports of gooseberries into the United Kingdom have been falling rapidly during the last six years. There was a further decline in 1932 to under 11,000 cwts. the lowest total recorded in post-war years and 35 per cent. below that of the previous year. Imports from both Holland and Belgium, which together furnish the bulk of the imported supplies, fell to new low levels. The Irish Free State accounts for practically the whole of the imports from Empire countries and the quantity imported from that country last year was well above the average of recent years. As compared with the home crop, which has averaged 650,000 cwts. during the past five years, imports are very small and even with the addition of gooseberry pulp have averaged less than 7 per cent. of the total available supplies in the United Kingdom in recent years. Imports during the past six years are shown in Table I.

TABLE I.—*Imports of Gooseberries into the United Kingdom, 1927-32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Netherlands	46,194	19,983	10,384	20,638	13,451	8,856
Belgium	10,484	10,845	4,279	6,629	3,043	1,239
Other Foreign Countries ..	372	252	122	929	34	96
Total Foreign Countries ..	57,050	31,080	14,785	28,196	16,528	10,191
Total Empire Countries	215	439	763	342	269	633
Total ..	57,265	31,519	15,548	28,538	16,797	10,824

The season for imported gooseberries is practically limited to June and July, and unless the season is very late, the peak occurs in June. These two months account for all but a very small proportion of the total. The Dutch and Belgian seasons are roughly alike, but the bulk of the Irish Free State supplies arrive in July.

Table II shows imports by months during the past six years. The small imports recorded in the first four months of 1927 were in January and February, and were shown as coming from South Africa.

TABLE II.—*Imports of Gooseberries into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January-April ..	17	—	—	—	—	—
May	1,209	53	2	225	44	31
June	39,825	23,246	7,264	23,689	11,854	9,637
July	16,777	7,417	7,923	4,511	4,573	1,129
August	2	803	328	113	326	27
September ..	—	—	31	—	—	—
Total	57,830	31,519	15,548	28,538	16,797	10,824

Imports of gooseberry pulp into the United Kingdom from the Netherlands are considerably more important than imports of the raw fruit from that country. The United Kingdom trade returns do not separately distinguish imports of gooseberry pulp, but the Dutch trade returns indicate that in each of the past two years about three times as much pulp was exported to the United Kingdom as raw fruit. As shown on page 80 exports of gooseberry pulp from the Netherlands to this country amounted to about 38,600 cwts. (gross) in 1931 and 26,300 cwts. (gross) in 1932.

IMPORTS OF GRAPEFRUIT

The very rapid increase in imports of grapefruit, which had proceeded unchecked throughout the post-war period up to and including 1931, suffered the first set-back in 1932, when imports fell to a level somewhat lower than in 1931, but still considerably above that of preceding years. The decline was entirely due to lighter foreign supplies, imports from Empire countries in 1932 being higher than ever previously recorded.

Although the United States continues to be the principal source of supply, it is becoming less important in relation to total imports, accounting in 1932 for 56 per cent. of all imports as compared with 64 per cent. in 1931, 70 per cent. in 1930 and 78 per cent. in 1929. Grapefruit shown as coming from the United States probably includes some proportion of fruit originating in other countries, particularly

Jamaica, Porto Rico and Cuba (Isle of Pines) and shipped to the United Kingdom via New York, but direct shipments from these countries have increased considerably in recent years.

Table I shows imports during the past six years.

TABLE I.—*Imports of Grapefruit into the United Kingdom, 1927–32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
South Africa	17	19	26	47	65	75
British West Indies	30	32	41	25	35	72
Palestine	(a)	(a)	3	10	36	81
Canada	4	2	2	7	1	(a)
British Honduras	(a)	1	1	(a)	1	2
Other Empire Countries..	1	1	2	1	(a)	1
United States	314	371	420	391	570	436
Porto Rico	6	—	7	26	79	36
Cuba	2	38	16	37	81	41
Portuguese East Africa ..	2	4	7	5	12	18
Brazil	—	—	1	(a)	1	9
Other Foreign Countries..	3	5	17	8	15	10
Total Empire Countries..	52	55	75	90	138	231
Total Foreign Countries..	327	418	468	467	758	550
Total	379	473	543	557	896	781

(a) Less than 500 cwts.

Imports from each of the principal Empire sources of supply in 1932 were higher than ever previously recorded. Imports from South Africa continued their uninterrupted upward movement to a new high level of 75,000 cwts. in 1932, while supplies from the British West Indies, after averaging about 30,000 cwts. during the previous six years, jumped in 1932 to 72,000 cwts. But Palestine has recorded the most remarkable expansion in recent years. Imports from that country, which up to 1929 were comparatively negligible and only reached the modest total of 3,000 cwts. in that year, headed the list of imports from Empire countries in 1932 with a total of

81,000 cwts. Imports from the Empire accounted for nearly 30 per cent. of all imports, as compared with barely 16 per cent. in 1931.

Imports from Portuguese East Africa rose to a new high level in 1932, while Brazil, which recorded a substantial advance in shipments to this country as compared with previous years, now figures in the import table as a new potential source of supply. Total imports from foreign sources, however, showed a heavy decline in 1932 as compared with the previous year and accounted for little more than 70 per cent. of total imports, as against 84 per cent. in 1931.

Table II shows imports by months over the last six years. There is no markedly seasonal movement, the relative proportions of fruit coming from the different sources in the various years accounting for the greater part of the changes in imports from month to month.

In 1932, imports during the two months June and July were unusually heavy and accounted for 30 per cent. of the total supplies for the year; the figures for each of these months being heavier than ever previously recorded for any month. It is a remarkable illustration of the development in the consumption of grapefruit that aggregate imports for these two months in 1932 exceeded total imports in the whole of 1926.

TABLE II.—Imports of Grapefruit into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	22	31	29	24	45	36
February	25	35	38	60	51	41
March	45	44	57	78	52	59
April	28	53	66	30	87	45
May	29	53	58	47	94	63
June	39	33	53	47	92	117
July	36	24	46	56	114	116
August	19	35	51	25	67	41
September	14	40	32	49	81	86
October	57	21	28	54	78	68
November	35	55	69	39	58	50
December	30	49	16	48	77	59
Total	379	473	543	557	896	781

Table III shows imports by months and countries of consignment, during 1932.

TABLE III.—*Imports of Grapefruit during each Month of 1932, showing Countries whence consigned.*

Month.	South Africa.	British West Indies.	Palestine.	United States, Porto Rico and Cuba.	Portuguese East Africa.	Other Countries.	Total.
	Thousand cwts..	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	—	4	7	24	—	1	36
February	—	8	5	27	—	1	41
March	—	10	8	40	—	1	59
April	—	2	5	37	—	1	45
May	2	2	2	53	1	3	63
June	13	2	—	94	5	3	117
July	18	—	—	88	6	4	116
August	16	—	—	19	3	3	41
September	21	2	—	59	3	1	86
October	5	10	4	48	—	1	68
November	—	11	25	12	—	2	50
December	—	21	25	12	—	1	59
Total	75	72	81	513	18	22	781

Most of the United States grapefruit shipped to the United Kingdom is grown in Florida, where the harvesting season starts about September and continues to about May, with peak supplies about March or April. Texas supplies come at about the same season, although the peak occurs about December or January; imports from Texas are, however, negligible. California produces grapefruit throughout the year and shipped substantial quantities to this country in 1932. The Southern Californian peak occurs in the summer months (June or July) and other Californian in the winter.

Other countries whose grapefruit shipments are partly indistinguishable in British import returns from those of the United States are Jamaica, Porto Rico and Cuba (Isle of Pines). In each case the earliest fruit is ready some weeks before the Florida season opens, and every effort is made to get the fruit on to the markets at an early date. Jamaica exports run from September to about March; Porto

Rico, with three distinct crops in the year, shows peak shipments in September or October, and secondary peaks in the spring and early summer according to the size of the respective crops; while the Isle of Pines covers much the same period. But each of these countries actually produces grapefruit throughout the year.

In the Union of South Africa the harvesting season is in the middle of the year; the bulk of the imports arriving in the four months June to September together with arrivals from Portuguese East Africa. Imports from Palestine extend from October to April, and in 1932 the heavy arrivals in November and December coincided with a period when supplies from the United States were unusually light.

IMPORTS OF GRAPES

There was a decline in imports of grapes in 1932 from the level of the previous year, the total of 905,000 cwts. showing a decrease of 39,000 cwts. Imports from Empire countries, however, were the largest so far recorded in any year, mainly due to a further advance in imports from South Africa to a new high level. Empire countries accounted for just over 10 per cent. of all imports in 1932 as against 9 per cent. in the previous year. Another feature of the year was the substantial drop in imports of glasshouse produce from each of the principal sources of supply.

The annual figures of imports of grapes into this country are very largely influenced by the size of the Spanish (Almeria) grape crop. Imports from Spain comprise the bulk of the total, the proportion in recent years ranging from 59 per cent. in 1926 and 1930 to 80 per cent. in 1924. The Almeria crop in 1932 was rather better than in the previous year and imports from Spain reached the highest figure recorded since 1925. The Spanish share of all imports rose to 70 per cent. as against 60 per cent. in 1931, but the proportion of the total from foreign sources, other than Spain, declined to 20 per cent. as compared with 30 per cent. in the previous year.

There was a marked decline in imports from both Belgium and the Netherlands in 1932, as compared with recent years. For a considerable number of years imports of grapes from Belgium have shown very little variation and during the previous five years averaged 54,000 cwts., with a slight increasing tendency. Imports from the Netherlands showed a fairly rapid expansion in recent years up to 1931, supplies in that year being second in importance to imports

from Spain. The decline in imports from Belgium in 1932 as compared with the previous year was 55 per cent., and in the case of the Netherlands the decline was as much as 66 per cent. Supplies from Portugal were again fairly heavy and above the average of recent years. Imports from the United States more than doubled in 1932 as compared with imports in the two previous years, but supplies from Argentina, following the record established in the previous year, had a set back to the lowest level recorded since 1927.

Table I shows imports annually since 1927.

TABLE I.—*Imports of Grapes into the United Kingdom, 1927–32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
South Africa ..	50	44	49	48	59	68
Channel Islands ..	20	15	15	27	21	15
Australia	5	2	7	4	5	9
Other Empire Countries	2	1	(a)	1	1	1
Spain	444	597	591	412	569	630
Belgium	50	54	57	53	58	26
Netherlands	51	48	68	66	86	29
Portugal	78	34	41	38	70	64
Argentina	9	20	18	17	28	16
United States	2	9	5	16	16	37
Italy	5	7	4	11	18	8
Other Foreign Countries	2	9	9	2	13	2
Total Empire Countries ..	77	62	71	80	86	93
Total Foreign Countries ..	641	778	793	615	858	812
Total ..	718	840	864	695	944	905

(a) Less than 500 cwts.

The Union of South Africa is the chief Empire country shipping grapes to the United Kingdom. The 1932 total marked a further advance in imports and the Dominion was second only in importance

to Spain among all countries of consignment. There was a decline in imports from the Channel Islands, but supplies from Australia showed an advance as compared with previous years. As stated above, total Empire supplies established a new high record.

The predominance of Spain in this country's grape imports is clearly reflected in the season of maximum imports. The last five months of the year normally account for about 85 per cent. of the imports for the whole year, but the development of imports from South Africa and Argentina is tending to raise the proportion received in the earlier half of the year. February, June and July are the months of minimum imports, supplies during those months being very small. Table II shows imports by months during the past six years.

TABLE II.—*Imports of Grapes into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	6	7	15	13	18	17
February	5	10	7	9	14	10
March	21	17	19	20	30	31
April	27	21	30	19	33	33
May	18	17	22	28	26	25
June	6	15	8	9	6	7
July	7	8	8	7	10	6
August	68	45	67	39	61	59
September	173	125	145	117	216	163
October	208	291	272	198	307	219
November.. ..	154	174	212	174	171	222
December.. ..	25	110	59	62	52	113
Total.. ..	718	840	864	695	944	905

In Table III are shown imports during each month of 1932 from the principal countries of consignment. The countries can be divided into two groups, with pronounced seasonal movements, but Belgium ships grapes throughout the year. South Africa and Argentina account for the bulk of the supplies from February to June; the end of July normally sees the opening of the Channel Islands and Netherlands seasons, and from then until the end of the year grapes are received from these countries, with Spain, Portugal and the United States.

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TABLE III.—Imports of Grapes in each Month of 1932, showing Countries whence consigned.

Month.	South Africa.	Channel Islands.	Spain.	Portugal.	Belgium.	Netherlands.	Argentina.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	—	—	10	—	4	—	—	3	17
February	5	—	—	—	2	—	—	3	10
March ..	24	—	—	—	1	—	1	5	31
April ..	20	—	—	—	—	—	8	5	33
May ..	15	—	—	—	—	—	6	4	25
June ..	4	—	—	—	2	—	1	—	7
July ..	—	—	1	—	3	2	—	—	6
August ..	—	1	20	27	3	8	—	—	59
September	—	3	117	34	2	7	—	—	163
October	—	6	193	3	2	8	—	7	219
November	—	4	198	—	3	3	—	14	222
December	—	1	91	—	4	1	—	16	113
Total	68	15	630	64	26	29	16	57	905

IMPORTS OF LEMONS

Imports of lemons into the United Kingdom in 1932 were only slightly below the record established in 1930, and with the exception of that year were the highest ever reached. Imports from Italy, the chief source of supply, increased further to the new high record of 1,212,000 cwts., and accounted for nearly 90 per cent. of the total, but imports from Spain showed a further fall from the 300,000 cwts. recorded in 1929 and 1930. Imports from Syria were larger than in the previous year, but well below average. Imports from "other foreign countries" consist of fruit shipped from continental countries (mainly Germany) which have previously imported the fruit from Italy, Spain or elsewhere.

With larger supplies from South Africa and Palestine, the total from Empire countries last year was slightly higher than the previous record in 1929, but imports from Empire sources are still unimportant

and account for less than 2 per cent. of total imports. Some development, however, is indicated in South African supplies which have increased from only 600 cwts. in 1928 to 9,500 cwts. in 1932.

Table I shows imports of lemons during the past six years.

TABLE I.—*Imports of Lemons into the United Kingdom, 1927-32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Palestine	4·8	1·8	13·8	1·4	2·6	7·1
South Africa	—	0·6	0·7	2·4	3·9	9·5
Cyprus	—	0·3	1·0	—	2·6	1·0
Other Empire Countries	—	—	2·0	—	·3	—
Italy	1,014·0	868·8	999·6	1,076·1	1,156·2	1,212·4
Spain	165·9	165·4	300·1	301·4	186·0	173·6
Syria	22·2	44·2	15·4	53·5	9·2	18·6
United States	0·4	5·4	1·4	4·5	1·5	3·5
Other Foreign Countries	25·9	41·0	26·8	38·2	47·0	21·9
Total Empire Countries	4·8	2·7	17·5	3·8	9·4	17·6
Total Foreign Countries	1,238·4	1,124·8	1,343·3	1,473·7	1,399·9	1,430·0
Total	1,243·2	1,127·5	1,360·8	1,477·5	1,409·3	1,447·6

In Table II are shown monthly imports of lemons in recent years. The figures show no special feature, the imports being fairly well distributed over the year. Variation occurs in the seasons from year to year according as the early and late lemon crops vary in magnitude. Imports are usually at a minimum in May and again in August and September, coinciding with the termination of the Italian winter and summer seasons respectively.

TABLE II.—Imports of Lemons into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January	96	97	134	124	107	179
February	129	109	132	108	119	166
March	149	114	139	110	176	130
April	108	123	132	142	156	78
May	80	114	97	108	92	84
June	166	116	126	159	136	126
July	87	57	117	186	134	100
August	49	46	106	67	72	79
September	73	56	53	88	86	77
October	83	122	116	134	136	137
November	133	104	91	90	84	150
December	90	70	118	161	111	142
Total	1,243	1,128	1,361	1,477	1,409	1,448

Table III shows imports of lemons during each month of 1932 from the principal countries of consignment.

TABLE III.—Imports of Lemons in each month of 1932, showing Countries whence consigned.

Month.	Italy.	Spain.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	175	2	2	179
February	163	2	1	166
March	127	1	2	130
April	76	1	1	78
May	77	7	—	84
June	110	12	4	126
July	68	22	10	100
August	57	17	5	79
September	48	24	5	77
October	50	67	20	137
November	126	14	10	150
December	135	5	2	142
Total	1,212	174	62	1,448

IMPORTS OF LIMES

British trade returns classify limes with "other citrus fruit not elsewhere specified", that is with citrus fruits other than oranges, lemons and grapefruit. The bulk of the imports comes from Empire sources and consists mainly of limes. The British West Indies has been the principal source of supply during the past five years but imports have fluctuated considerably. In 1932, imports from the Gold Coast, a new source of supply, accounted for the bulk of the total shown as "from other countries". The following table shows imports of limes and other miscellaneous citrus fruits in the past six years.

Imports of Limes and other Citrus Fruit not elsewhere specified, 1927-32.

Year.				From British West Indies.	From other Countries.	Total.
				cwts.	cwts.	cwts.
1927	..	..	..	249	282	531
1928	..	..	..	1,193	96	1,289
1929	..	..	..	4,878	31	4,909
1930	..	..	..	861	329	1,190
1931	..	..	..	208	133	341
1932	..	..	..	708	427	1,135

IMPORTS OF ORANGES

Imports of oranges during the four years 1925 to 1928 showed little variation from year to year, the total remaining consistently just below 8,000,000 cwts. But in the succeeding two years there was a substantial upward movement, followed by a slight increase in 1931 which brought imports in that year to well over 10,000,000 cwts. and the highest level ever reached. This advance received a check in 1932; imports declined by over 1,000,000 cwts. in comparison with those of the previous year, and only slightly exceeded the 1929 total.

Aggregate imports in 1932 from South Africa and Palestine, the two principal Empire sources of supply, reached a total of 2,719,000 cwts. an increase of nearly 300,000 cwts. over the previous record in 1930. The Empire share of total imports was just under 30 per cent., as compared with 24 per cent. in that year.

Table I shows imports of oranges during the past six years.

TABLE I.—*Imports of Oranges into the United Kingdom, 1927–32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Palestine	1,359	1,103	791	1,323	1,289	1,639
South Africa	524	534	670	1,100	969	1,080
Southern Rhodesia }						
British West Indies	61	29	1	1	1	1
Australia	2	4	1	(a)	6	1
Cyprus	(a)	(a)	2	1	3	4
Other Empire Countries..	6	3	18	2	1	2
Spain	5,291	5,750	6,243	7,206	5,921	5,256
Italy	92	45	50	44	52	36
United States	431	106	979	38	846	293
Brazil	19	86	250	351	1,119	971
Argentina	12	8	48	1	25	2
Syria	3	3	1	4	7	1
Portuguese East Africa ..	9	7	10	11	34	22
Other Foreign Countries..	89	83	200	125	118	42
Total Empire Countries..	1,952	1,673	1,483	2,427	2,269	2,727
Total Foreign Countries..	5,946	6,088	7,781	7,780	8,122	6,623
Total	7,898	7,761	9,264	10,207	10,391	9,350

(a) Less than 500 cwts.

Imports from South Africa and Southern Rhodesia fell just short of the record quantity imported in 1930. The actual total shipped from the Union was 1,673,000 boxes (201,000 more than in 1931 and only 23,000 less than in 1930) and shipments from Southern Rhodesia, via Beira, Durban and Cape Town, amounted to 153,000 boxes, an increase of 9,000 boxes over the previous year.

Imports from Palestine were heavier than ever previously recorded and were 300,000 cwts. above the previous record imports in 1930. The imports in 1932 include shipments from Palestine to this country during the latter and major portion of the 1931–32 season and shipments during the early part of the 1932–33 season. As shown in the table which appears on page 118, total shipments to this country in

the 1931-32 season amounted to over 2½ million boxes and exceeded those of the previous record season (1929-30) by 566,000 boxes. The 1932-33 season showed a further substantial advance on previous seasons. Shipments to this country from the beginning of the season to the end of 1932 were some 150,000 boxes heavier than in the corresponding period of 1931.

Imports from Spain were the lowest recorded since 1921 and were nearly 700,000 cwts. lighter than in the previous year. As in the case of Palestine, all imports during the calendar year comprise the figures for the later (and major) part of one season and the first part of the next. Imports in 1932 included the relatively light shipments during the latter part of the 1931-32 season and during the first part of the 1932-33 season. Imports from Spain from January to June, inclusive, showed a fall of 500,000 cwts., and during November-December a decline of 200,000 cwts. as compared with the corresponding periods of 1931.

The striking rise in imports from Brazil in 1931 was not maintained in 1932, but imports in that year were nevertheless little short of 1,000,000 cwts. The phenomenal growth of the orange trade between Brazil and the United Kingdom, which is perhaps the most remarkable happening in the post-war orange trade, is the history of only a comparatively few years, imports in 1926 being less than 500 cwts. Shipments to this country during the 1932 season totalled about 1,500,000 boxes and fell short of the record 1931 shipments by some 200,000 boxes.

There was a substantial decline in imports from the United States in 1932 from the high level of the previous year, but the fall was not nearly so steep as that which occurred in 1930 following the large imports in 1929. Some 400,000 boxes were shipped to this country from California in the 1932 season as compared with 1,100,000 boxes in 1931.

Imports from South Africa, Brazil and the United States, the main sources of supply of oranges during the summer months, aggregated 2,344,000 cwts., as compared with 2,934,000 cwts. in 1931 and 1,489,000 cwts. in 1930.

The Brazilian and South African seasons approximately coincide, but variations occur in different years at the beginning and at the end of the seasons. In 1932 the first shipment from Brazil arrived in mid-April and the first shipment from South Africa a month later, but arrivals from South Africa continued up to mid-December,

whereas the last shipment from Brazil arrived in November. In 1931 when imports from Brazil reached record proportions arrivals of Brazilian oranges started earlier and finished later in the season than South African supplies. United States oranges do not begin to arrive in any considerable quantities until the close of the Spanish and Palestine seasons and Californian late Valencias comprise the bulk of the supplies.

Table II shows imports of oranges by months since 1927.

TABLE II.—*Imports of Oranges into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	916	1,106	1,301	1,424	1,464	1,258
February	1,104	1,266	909	1,258	958	1,299
March	1,232	1,031	1,232	1,465	1,323	1,353
April	814	1,110	806	1,262	983	861
May	575	767	594	1,007	801	679
June	428	434	607	702	623	377
July	304	183	347	484	661	412
August	144	128	448	270	477	408
September	172	130	430	295	378	456
October	228	182	308	387	547	554
November	503	421	537	312	553	275
December	1,478	1,003	1,745	1,344	1,623	1,418
Total	7,898	7,761	9,264	10,207	10,391	9,350

The development of the import of oranges into the United Kingdom from South Africa, California, and Brazil, has greatly increased the consumption of oranges during the summer months. It has spread consumption more evenly over the year; and to this more even distribution the extension of the Spanish orange season is to some extent a contributing factor. Even so short a time ago as 1924 the four months, December to March, accounted for 56 per cent. of the year's imports, while the four months from July to October accounted for only 6½ per cent. In 1932 the four months July to October accounted for nearly 20 per cent. of all imports, although over half the total for the year was still recorded in January to March and December.

Table III shows, for each of the chief countries whence supplies were drawn in 1932, the imports into the United Kingdom in each month.

TABLE III.—Imports of Oranges during each Month of 1932, showing Countries whence consigned.

Month.	Palestine	South Africa and Southern Rhodesia	Spain and Italy.	United States.	Brazil.	Portuguese East Africa.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	273	—	979	—	—	—	6	1,258
February	345	—	952	—	—	—	2	1,299
March	412	—	936	1	—	—	4	1,353
April	235	—	619	—	5	—	2	861
May	1	3	520	24	127	—	4	679
June	—	84	95	31	165	—	2	377
July	—	188	26	89	105	—	4	412
August	—	193	2	57	142	8	6	408
September	—	209	—	52	183	7	5	456
October	—	323	7	32	183	6	3	554
November	21	74	107	7	61	1	4	275
December	352	6	1,049	—	—	—	11	1,418
Total	1,639	1,080	5,292	293	971	22	53	9,350

IMPORTS OF PEACHES

The importation of raw peaches, which has been an outstanding feature of the fruit trade in post-war years, continued the upward movement to a new high level in 1932. In the space of seven years imports have more than quadrupled, total imports in 1926 being below 25,000 cwts.

Imports from Italy established a new record in 1932, but the rate of progress was considerably less striking than in the two previous years. It is reported that the area under peach cultivation in Italy continues to expand and that many new plantations reached the producing stage in 1932. Italian peaches accounted for 65 per cent. of all imports and 90 per cent. of foreign supplies. There was a sharp decline in United States supplies reflecting the light crop in Georgia, and imports from France were unusually small. On the other hand, imports from both Holland and Belgium reached new high levels.

From 1927 to 1930 South Africa was the United Kingdom's chief source of supply of raw peaches, but the Union was definitely displaced in this respect in 1931 and 1932 by Italy. Imports from South

Africa in 1932 were the highest yet recorded and the Empire share of total imports increased to nearly 30 per cent. as against 21 per cent. in the previous year. In 1930, however, the Empire contributed more than half of the very much smaller total imported supplies.

Table I shows imports of peaches during the past six years.

TABLE I.—*Imports of Peaches into the United Kingdom, 1927-32.*

Country, whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
South Africa	21,094	11,030	18,868	25,706	19,672	29,980
Canada	1,449	851	—	27	163	2
Other Empire Countries	351	2,017	557	665	41	—
Germany	12	59	89	73	732	585
Netherlands	379	236	203	281	625	1,154
Belgium	728	874	1,034	1,461	1,387	2,008
France	1,132	678	770	1,398	2,804	551
Italy	10,347	10,069	13,982	21,441	60,183	64,207
Spain	383	211	—	—	3	578
United States	1,550	4,641	1,084	321	7,711	451
Argentina.. .. .	9	—	—	—	59	385
Other Foreign Countries	62	—	20	51	631	204
Total Empire Countries..	22,894	13,898	19,425	26,398	19,876	29,982
Total Foreign Countries..	14,602	16,768	17,182	25,026	74,135	70,123
Total	37,496	30,666	36,607	51,424	94,011	100,105

In Table II are shown imports by months in the past six years.

TABLE II.—*Imports of Peaches into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	3,477	1,903	2,418	8,061	4,795	10,007
February	6,379	5,817	7,756	14,796	8,791	16,864
March	10,461	3,142	7,416	2,561	5,432	2,173
April	212	92	273	30	39	210
May	492	212	1,724	152	57	71
June	946	891	856	1,419	630	1,113
July	3,608	3,278	3,631	6,007	11,842	8,685
August	7,229	6,955	6,963	11,659	29,750	33,001
September	3,325	2,737	4,016	5,450	27,892	23,497
October	635	3,441	947	1,047	3,330	3,251
November.. .. .	134	1	—	1	492	—
December.. .. .	598	2,197	607	241	961	1,233
Total	37,496	30,666	36,607	51,424	94,011	100,105

There are two well defined seasons of imports, the winter months of December, January, February and March and the summer months July to October. These, of course, reflect the supplies from the two chief sources, South African peaches arriving in the winter, and Italian, United States and other European peaches in the summer. In the interval between the seasons imports are very small. Supplies from South Africa on the one hand and Italy on the other may show further considerable development; the seasons are sufficiently distinct to eliminate any degree of competition, at any rate so far as the fresh peach market is concerned, and it is not unlikely that the dual source of supplies, by bringing peaches on to the market almost throughout the year, may be definitely advantageous to both. Table III below gives imports in 1932 from the chief countries of consignment, and clearly shows the seasons of supply.

TABLE III.—*Imports of Peaches during each Month of 1932, showing Countries whence consigned.*

Month.	South Africa.	Argentina.	Italy.	Netherlands.	Belgium	United States.	Other Countries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	1,0007	—	—	—	—	—	—	10,007
February	16,819	45	—	—	—	—	—	16,864
March	1,921	136	—	—	—	—	116	2,173
April	—	204	—	6	—	—	—	210
May	—	—	—	9	62	—	—	71
June	—	—	649	39	143	17	265	1,113
July	—	—	7,423	223	312	—	727	8,685
August	—	—	30,859	564	421	408	749	33,001
September	—	—	22,205	313	892	26	61	23,497
October	—	—	3,071	—	178	—	2	3,251
November	—	—	—	—	—	—	—	—
December	1,233	—	—	—	—	—	—	1,233
Total	29,980	385	64,207	1,154	2,008	451	1,920	100,105

IMPORTS OF PEARS

Imports of pears into the United Kingdom in 1932, at 1,113,000 cwts., failed to reach the high level recorded in the previous year, but imports from Empire sources were heavier and resulted in an increase in the Empire share of total imports from 20 per cent. in 1931 to 27 per cent. in 1932. In 1930, however, the Empire proportion was 31·3 per cent. Table I shows imports during the past six years.

TABLE I.—Imports of Pears into the United Kingdom, 1927-32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Canada	31	60	30	64	46	49
Australia	31	58	48	130	145	120
New Zealand	11	18	15	19	19	40
South Africa	35	101	24	108	40	91
Other Empire Countries..	2	3	3	1	1	1
Belgium	554	275	543	231	349	210
France	139	47	145	19	36	5
United States	199	225	217	434	492	532
Italy	24	24	11	9	47	31
Netherlands	26	30	28	8	22	12
Germany	17	9	5	—	36	2
Spain	5	5	8	2	1	2
Argentina	(a)	(a)	(a)	(a)	1	17
Other Foreign Countries	3	5	1	4	2	1
Total Empire Countries..	110	240	120	322	251	301
Total Foreign Countries..	967	620	958	707	986	812
Total	1,077	860	1,078	1,029	1,237	1,113

Imports from New Zealand established a new record, and were more than double those of any previous year, but imports from Australia were lower than in either of the previous two years. Combined imports, however, from these two countries in 1932 fell little short of the record combined imports of the previous year. Following the light crop year in 1931, imports from South Africa in 1932 made the usual recovery but failed to reach the high level of recent previous good crop years. Imports from Canada were slightly higher than in 1931.

The United States, which had in 1930 assumed the place of chief overseas source of supply of pears on the British market, further strengthened its position in 1932 and accounted for nearly 48 per cent. of the total imports. In fact, for the third year in succession, imports of pears from the United States exceeded in volume the estimated production in the United Kingdom.

Imports from Belgium, which was the principal source of imported supplies from 1926 to 1929, declined in 1932 to the lowest level recorded since 1925, while imports from France were relatively negligible and the lowest recorded in post-war years. As comparatively recently as 1924 imports from France totalled no less than 347,000 cwts. Imports from Argentina, which up to last season had shown little sign of any important expansion, increased substantially in 1932.

In Table II are shown imports during each month of the past six years. Imports in the first six months of 1932 accounted for nearly 30 per cent. of the total, as compared with less than 10 per cent in 1926. This more even distribution of supplies over the year is due partly to the increase in the proportion coming from the southern hemisphere, and partly to the more prominent place taken by the United States, as imports from that country, which begin in July, extend right up to the spring of the following year.

TABLE II.—*Imports of Pears in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	25	12	32	18	50	37
February	21	16	19	22	39	40
March	25	47	26	50	83	64
April	13	50	21	54	59	64
May	26	45	35	79	71	93
June	10	22	17	54	40	27
July	57	30	20	33	60	10
August	340	282	334	205	257	186
September.. ..	306	159	279	169	288	269
October	163	95	177	145	157	174
November.. ..	56	55	72	78	60	104
December	35	47	46	122	73	45
Total.. ..	1,077	860	1,078	1,029	1,237	1,113

Table III gives imports in 1932 from each country by months. The South African season runs from February to May, and coincides with the Argentine season. Australian and New Zealand supplies come forward one or two months later (partly accounted for by the longer voyage). The Belgian and Italian seasons run from August to October. The peak of the United States imports falls in October, but fairly substantial shipments continue right up to February or March.

TABLE III.—Imports of Pears in each Month of 1932, showing Countries whence consigned.

Month.	Australia and New Zealand.	South Africa.	Argentina.	Belgium.	Italy.	Canada and United States.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	—	—	—	—	—	37	—	37
February	1	21	2	—	—	16	—	40
March ..	9	43	9	—	—	3	—	64
April ..	34	25	5	—	—	—	—	64
May ..	89	2	1	—	1	—	—	93
June ..	26	—	—	—	—	—	1	27
July: ..	1	—	—	1	—	7	1	10
August ..	—	—	—	105	19	56	6	186
September	—	—	—	89	9	163	8	269
October ..	—	—	—	11	2	157	4	174
November	—	—	—	3	—	99	2	104
December	—	—	—	1	—	43	1	45
Total..	160	91	17	210	31	581	23	1,113

IMPORTS OF PINEAPPLES

Fresh pineapples were not separately distinguished in the British trade returns before the year 1928. Since that year imports have risen from 45,000 to nearly 68,000 cwts., with the bulk of the total coming from the Azores. Of other sources of supply, the Union of South Africa is the most important and small quantities are credited to a number of less important sources.

Imports from the Azores have shown a fairly steady expansion, while those from South Africa, after reaching a peak of over 10,000 cwts. in 1929 declined in the two succeeding years, but recovered partially last year to nearly 8,000 cwts.

The United States, with Cuba and Porto Rico account for a large proportion of the supplies from foreign countries other than the Azores, but imports fluctuate considerably from year to year. Brazil and Madeira show signs of development as further sources of supply.

Table I shows imports during the past five years.

TABLE I.—Imports of Pineapples into the United Kingdom, 1928–32.

Country whence consigned.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.
South Africa ..	6,394	10,315	5,413	4,253	7,900
Straits Settlement ..	125	460	258	40	1
British West Indies ..	165	58	12	—	24
Nigeria	—	6	1	27	107
Other Empire Countries	149	23	35	—	32
Azores	37,769	41,433	49,461	57,049	54,222
Brazil	288	934	259	629	797
Madeira	—	61	2	715	788
United States ..	5	553	420	3,130	1,257
Porto Rico	—	74	1,579	442	127
Cuba	—	—	1	285	2,128
Other Foreign Countries	220	1,849	144	172	369
Total Empire Countries	6,833	10,862	5,719	4,320	8,064
Total Foreign Countries	38,282	44,904	51,866	62,422	59,688
Total ..	45,115	55,766	57,585	66,742	67,752

The distribution of imports over the year 1932 is shown in Table II.

TABLE II.—Imports of Pineapples in each Month of 1932, showing Countries whence consigned.

Month.	South Africa.	Azores.	United States, Porto Rico and Cuba.	Other Countries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.
January	—	7,745	16	231	7,992
February	135	6,878	—	97	7,110
March	2,260	3,982	20	60	6,322
April	2,391	1,820	421	97	4,729
May	1,561	2,997	1,301	20	5,879
June	543	3,117	450	83	4,193
July	103	2,809	98	5	3,015
August	404	3,333	519	21	4,277
September	186	2,123	687	130	3,126
October	317	4,351	—	249	4,917
November	—	3,023	—	588	3,611
December	—	12,044	—	537	12,581
Total	7,900	54,222	3,512	2,118	67,752

Imports from the Azores are recorded throughout the year, but tend to concentrate upon the winter months, December being the peak month, reflecting the Christmas demand. The South African season runs from February to October.

IMPORTS OF PLUMS

Total imports of plums and greengages in 1932 were the lowest recorded since the years 1921 and 1922, when the imports totalled only about 168,000 cwts. The decline was mainly due to a heavy fall in imports from France, which is normally the principal source of supply, and substantial declines in imports from Holland, Belgium and the United States. Light crops in the first three-named countries undoubtedly accounted to a large extent for this decline. On the other hand, supplies from Empire sources were the largest yet recorded, imports from both South Africa and Canada reaching a new high level. Imports of Spanish plums and greengages showed a substantial recovery from the set back of the previous year, but imports from Italy, Germany and Hungary failed to reach the high levels of 1931. Yugoslavia, whence imports have hitherto been negligible, figured prominently in 1932 among the principal sources of supply. Table I shows annual imports during the past six years.

TABLE I.—*Imports of Plums into the United Kingdom, 1927-32.*

Country whence consigned	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
South Africa	17,721	15,142	16,764	27,318	29,144	32,016
Canada	11,482	18,171	6,601	6,227	12,939	20,102
Irish Free State	2,068	2,158	1,419	2,670	375	65
Australia	71	—	791	180	3,613	140
New Zealand	—	—	—	—	7	—
France (including Algeria)	288,913	120,539	208,483	162,217	95,356	21,406
Belgium	66,952	68,469	74,139	25,824	19,796	9,331
Germany	69,016	121,115	64,690	5,357	110,925	76,512
Italy	31,429	44,733	50,464	65,589	77,708	63,146
Netherlands	13,996	11,527	12,565	2,404	37,261	13,540
United States	40,123	42,610	21,458	37,006	63,782	13,493
Spain	52,990	31,179	45,795	54,128	36,130	68,363
Hungary	—	—	—	—	23,762	8,882
Yugoslavia	—	—	—	—	489	13,983
Other Foreign Countries..	2,637	4,613	2,087	184	1,978	2,776
Total Empire Countries	31,342	35,471	25,575	36,415	46,078	52,323
Total Foreign Countries	566,056	444,785	479,681	352,716	467,187	291,432
Total	597,398	480,256	505,256	389,131	513,265	343,755

As a result of the increased imports from Empire countries and the lower supplies from foreign sources, the proportion of total imports furnished by the Empire rose to 15 per cent. in 1932, as compared with 9 per cent. in each of the two previous years.

In Table II are shown monthly imports during the past six years. The main season is usually concentrated around the months of July and August, but the relative importance of the different months varies with the earliness or lateness of the season and with the varying supplies contributed by the different countries. Thus in 1931, and to a greater extent in 1932, the decline in French supplies in comparison with imports from Germany and central European countries had the effect of making September, and in 1932 even October, as important as July.

TABLE II.—*Imports of Plums into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	3,911	3,781	4,098	14,661	8,968	12,183
February	5,160	4,269	7,378	6,835	6,363	9,470
March	7,650	6,386	5,212	5,513	12,013	10,297
April	905	498	1,272	435	4,819	30
May	592	742	648	50	686	800
June	23,898	18,796	28,860	21,077	38,303	8,889
July	189,405	102,954	149,703	162,916	118,249	55,133
August	183,183	142,201	180,670	141,502	153,494	137,351
September	132,873	112,467	67,137	13,278	131,897	55,651
October	49,887	77,256	53,462	21,588	34,160	52,684
November	310	6,588	4,037	1,193	3,680	503
December	47	4,328	2,779	83	633	764
Total	597,821	480,266	505,256	389,131	513,265	343,755

Table III shows monthly imports in 1932 by countries of consignment. During the early months of the year the Union of South Africa has almost a clear field, but supplies from Argentina, which commenced to ship plums on a commercial scale in 1931, are increasing. The earliest plums from the Continent consist of Algerian and Southern French produce, Italian plums and Spanish greengages. Supplies from France, Spain and Italy reach their peak in July or August, according to the earliness or lateness of the season. Belgian and Dutch plums usually reach their peak in August, and German, Hungarian and Yugoslavian plums in September, but August was the peak month for German plums in 1932. Supplies from North America are usually at their height in October.

TABLE III.—Imports of Plums in each Month of 1932, showing Countries whence consigned.

Month.	South Africa.	Algeria, France, Spain, Italy.	Belgium, Netherlands.	Germany, Hungary, Yugoslavia.	Canada, United States.	Argentina.	Other Countries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	12,183	—	—	—	—	—	—	12,183
February	9,422	—	—	—	—	48	—	9,470
March	9,620	—	—	—	—	537	140(a)	10,297
April	27	—	—	—	—	3	—	30
May	—	674	20	—	106	—	—	800
June	—	7,853	—	—	1,036	—	—	8,889
July	—	49,253	1,849	437	3,536	—	58	55,133
August	—	86,687	10,210	41,839	4,504	—	111	137,351
September	—	9,416	7,626	30,174	8,060	—	375	55,651
October	—	5,032	3,166	26,839	16,056	—	1,591	52,684
November	—	—	—	88	297	—	118	503
December	764	—	—	—	—	—	—	764
Total	32,016	152,915	22,871	99,377	33,595	588	2,393	343,755

(a) Australia.

IMPORTS OF STRAWBERRIES

Apart from a set back in 1930 imports of fresh strawberries had increased steadily to a record high level of nearly 90,000 cwts. in 1931, but 1932 witnessed a substantial fall to the lowest level recorded in post-war years. Imports of French strawberries, which had established a record in 1931, amounted to barely one-third of the

previous years' total, and there was also a substantial decline in Dutch strawberries. France and Holland together account for practically the whole of the imported supplies, small quantities from the Channel Islands and Irish Free State in certain years being the only Empire contribution. Table I shows imports during the past six years.

TABLE I.—*Imports of Strawberries into the United Kingdom, 1927–32.*

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Netherlands	29,130	29,323	23,956	33,004	33,793	22,267
France	42,066	48,904	55,076	34,322	55,694	18,489
Other Foreign Countries..	214	263	440	305	405	44
Total Foreign Countries	71,410	78,490	79,472	67,631	89,892	40,800
Total Empire Countries	17	113	745	49	—	7
Total ..	71,427	78,603	80,217	67,680	89,892	40,807

Imports of fresh strawberries are far less important than imports of strawberry pulp. The table on page 79 shows that 166,000 cwts. of pulp, mainly from the Netherlands, were imported in 1932, or more than four times the quantity of fresh fruit imported in the same year. Comparable figures are not available for previous years, but Netherlands trade returns show that exports of strawberry pulp from that country to the United Kingdom from 1927 to 1931 inclusive averaged about 170,000 cwts., gross weight. The combined imports of strawberries and strawberry pulp in 1932 thus exceeded 200,000 cwts., and during the previous five years must have averaged fully 230,000 cwts.

The earliest strawberries are grown under glass and come from Holland, while the first outdoor strawberries are imported from France. The Dutch outdoor season is slightly later. Imports are mainly concentrated within the two months June and July, with the peak point in June, except when the season is unusually late as occurred last year. Details are shown in Table II.

TABLE II.—Imports of Strawberries into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	4	—	—	—	—	—
February	—	—	—	—	—	—
March	—	—	—	41	—	—
April	5	9	1	11	5	3
May	1,928	877	758	1,572	1,462	15
June	41,485	50,256	49,741	50,048	61,518	9,123
July	26,564	25,634	28,706	15,515	25,083	31,652
August	1,441	1,577	464	29	1,821	8
September	—	—	532	121	3	1
October	—	250	15	343	—	—
Total.. .. .	71,427	78,603	80,217	67,680	89,892	40,807

IMPORTS OF UNCLASSIFIED FRUITS

Imports of fruits not separately distinguished in the United Kingdom trade returns totalled 387,000 cwts. in 1932. Particulars are shown in Table I, but figures for 1928-32 are not comparable with those for 1927, which included imports of pineapples. This accounts for the fall of about 36,000 cwts. in imports from the Azores and of 18,000 cwts. from South Africa between 1927 and 1928.

Of the unclassified fruit nearly 70 per cent. was imported in 1932 from Spain, with Germany, Netherlands, Norway, France and the Irish Free State next in order of importance. Although no particulars are available from British trade returns as to the different kinds of fruit going to make up the total in 1932, a reasonably accurate analysis can be compiled from information received from the ports where the fruit is imported. These particulars are published week by week in the "Weekly Fruit Intelligence Notes".

Spain.—Practically the whole of the unclassified fruit imported from Spain consists of melons and pomegranates and imports of these fruits in 1932 showed little change from the previous year. According to the information received by the Board, the total included about 150,000 cwts. of melons and about 100,000 cwts. of pomegranates. The United Kingdom is almost the only market for both these Spanish fruits.

TABLE I.—Imports of Unclassified Fruits into the United Kingdom, 1927-32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Channel Islands	1,781	1,449	1,705	2,483	2,368	1,000
Irish Free State	10,486	12,893	16,946	5,440	9,487	9,349
South Africa	20,138	2,333	3,414	1,850	2,416	1,968
Other Empire Countries	3,772	2,434	4,418	2,795	2,089	4,192
Norway	6,781	10,166	13,808	10,341	5,599	10,751
Germany	11,898	18,827	28,859	30,325	50,241	38,981
Netherlands	13,699	12,987	22,025	25,555	22,764	27,134
Belgium	5,311	6,071	5,890	2,319	3,524	1,583
France	20,196	24,529	19,843	15,571	17,352	9,892
Azores	36,829	897	4	36	64	34
Spain	206,511	306,268	242,977	272,218	287,565	267,176
United States	6,939	3,066	2,885	1,856	3,382	4,185
Other Foreign Countries	11,961	8,624	13,425	9,877	9,296	10,980
Total Empire Countries..	36,177	19,109	26,483	12,568	16,360	16,509
Total Foreign Countries..	320,125	391,435	349,716	368,098	399,787	370,716
Total.. ..	356,302*	410,544	376,199	380,666	416,147	387,225

* The year 1927 includes pineapples.

Germany.—Imports of unclassified fruit from Germany consist almost entirely of bilberries.

Netherlands.—Melons accounted for over 50 per cent. of the imports from the Netherlands. Cranberries and bilberries in about equal quantities and a small quantity of raspberries make up the balance.

Norway.—Over 90 per cent. of the imports from Norway are bilberries, the balance consisting of other berry fruits, such as cranberries and whortleberries.

France.—Melons, bilberries and green figs make up the bulk of the French imports, supplemented by smaller quantities of other fruits, such as quinces and medlars.

Irish Free State.—Bilberries and blackberries account for the major part of the imports from the Irish Free State. The Board's returns fall short of the recorded imports and the difference may be accounted for by imports into Northern Ireland across the land boundary of which the Board have no particulars.

Channel Islands.—Practically the whole of the imports from the Channel Islands consist of melons and figs. The 1932 total included about 800 cwts. of melons and about 200 cwts. of figs.

South Africa.—The South African imports are all recorded during December and the first five months of the year and consist for the major part of melons, supplemented by a range of fruits, such as pomegranates, grenadillas, litchies, custard apples, mangoes and persimmons.

Belgium.—Bilberries and small quantities of melons make up the bulk of the imports from Belgium, according to the Board's information.

Other Countries.—Imports from other countries consist of a variety of fruits, which the Board's returns are insufficient wholly to classify. A fair proportion of the total is made up of melons from Hungary, Italy and other countries; cranberries from the United States, Sweden, Estonia, Finland, and Poland; bilberries from Poland and Finland; elderberries from Portugal and pomegranates from Cyprus and Portugal. Maderia sends small quantities of several minor fruits such as grenadillas, custard apples, delicious fruit, passion fruit, avocado pears and chow chows.

TABLE II.—*Imports of Unclassified Fruits in each Month of 1932, showing Countries whence consigned.*

Month.	Irish Free State.	Chan-nel Islands.	Ger-many.	Nether-lands.	France.	Spain.	Other Coun-tries.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	—	—	—	178	14	194	166	552
February ..	—	1	—	340	91	82	377	891
March ..	—	—	—	60	5	61	1,044	1,170
April ..	—	5	—	—	10	95	382	492
May ..	—	162	—	2	15	56	870	1,105
June ..	13	266	147	623	380	—	2,248	3,677
July ..	1,389	182	22,351	7,594	1,095	49,235	4,334	86,180
August ..	1,358	166	15,427	10,366	1,769	68,193	8,410	105,689
September ..	6,551	134	489	5,086	1,085	109,799	6,885	130,029
October ..	36	71	173	1,713	2,100	29,737	2,616	36,446
November ..	1	13	121	635	2,020	7,273	3,031	13,094
December ..	1	—	273	537	1,308	2,451	3,330	7,900
Total ..	9,349	1,000	38,981	27,134	9,892	267,176	33,693	387,225

On the whole it is evident that of the 387,000 cwts. of fruit not separately distinguished imported in 1932, melons accounted for about 50 per cent., pomegranates for about 25 per cent., and bilberries for about 15 per cent.; the remaining 10 per cent., being made up of a large variety of fruits of which cranberries and figs were the most important.

The different fruits included in the miscellaneous group are reflected in the seasonal imports as shown in Table II. Melons from the Channel Islands arrive from May onwards and figs start about June or July, while the French season for each of these fruits is slightly later. Bilberries come in from all countries from July to about October, and cranberries from October to December. The Spanish melon season opens in July and runs to September, while shipments of pomegranates start about the end of August and continue into November, imports being recorded into December.

IMPORTS OF FRUIT PULP

Except for small quantities recorded as imported "preserved in syrup" (amounting to only 4,944 cwts. in 1931), fruit pulp is not separately distinguished in the Trade Returns of the United Kingdom, and the large consignments of pulp annually imported are included, together with fruit in other forms and not necessarily pulped, under the heading "Fruit preserved without sugar," which is further sub-divided into "Canned or Bottled" and "Other than Canned or Bottled."

It is not possible to determine with precision how much of the fruit included in these categories consists of fruit pulp, and how much of fruit in other forms, nor can the proportion of the different kinds of fruit be obtained with any exactitude, although certain varieties are now separately enumerated. But an examination of the trade returns of the exporting countries, of the seasons of the year when shipments are made and of other records, together with knowledge of the varieties of fruit grown in the particular countries concerned, affords some guidance as to the quantities and varieties of fruit involved.

Imports of fruit preserved without sugar, canned or bottled, during the past six years and the principal consigning countries are given in Table I; and similar imports, other than canned or bottled, in Table V.

TABLE I.—Imports of Fruits, Preserved without Sugar
(Canned or Bottled).

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Canada	4.9	5.3	3.3	3.2	16.7	25.1
Australia	8.4	20.5	13.7	8.2	1.1	15.2
Other Empire countries	1.3	1.4	3.7	3.1	1.5	3.6
United States	130.6	150.4	217.3	132.4	153.0	158.6
Spain	125.3	93.0	130.7	119.0	131.8	146.3
Netherlands	24.0	14.6	13.6	13.7	17.3	8.1
France	16.8	16.3	20.0	13.1	11.1	13.6
Belgium	4.1	5.7	7.7	8.1	7.2	2.4
Italy	2.1	1.9	6.0	5.6	1.5	2.5
Other Foreign countries	6.2	4.7	15.1 (a)	17.4 (b)	16.2 (c)	9.7 (d)
Total Empire countries	14.6	27.2	20.7	14.5	19.3	43.9
Total Foreign countries	309.1	286.6	410.4	309.3	338.1	341.2
Total	323.7	313.8	431.1	323.8	357.4	385.1

(a) Including Russia, 8.5; Germany, 4.0.

(b) Including Russia, 10.6; Austria, 2.8; Germany, 1.6.

(c) Including Russia, 12.9.

(d) Including Russia, 6.0.

Imports of canned and bottled fruit, preserved without sugar, in 1932, showed an appreciable advance on the 1931 total, and at 385,000 cwts. were substantially above the average of 350,000 cwts. for the previous five years.

The share of Empire countries in the total showed a substantial increase in 1932, and amounted to 11 per cent. as compared with about 5 per cent. only in each of the previous three years. Canada was the chief Empire source in 1932; imports from that Dominion have risen sharply in the past two years and totalled 25,000 cwts. in 1932 as compared with 17,000 cwts. in 1931. Shipments from Canada consist in the main of canned apples, and small quantities of soft fruit pulp. After showing a rapidly declining trend for several years, imports from Australia rose sharply in 1932 to 15,000 cwts., which compared with only 1,000 cwts. in 1931. The greater part of the fruit shipped from Australia is raspberry pulp. Imports

from Straits Settlements, which probably consist of crushed pineapple, and from South Africa, which are mainly soft fruit pulp, comprise most of the remainder of the Empire supplies.

About 89 per cent. of the canned and bottled fruits preserved without sugar were imported from foreign countries in 1932, the most important being the United States and Spain, which between them contributed nearly 80 per cent. of the total. Imports from the United States, which consist mainly of canned apples, were slightly larger than in the previous year, and consignments from Spain, which are chiefly apricot pulp, were appreciably greater. Among countries of lesser importance, imports from Netherlands, Belgium and Russia declined, but those from France increased; these supplies consist largely of soft fruit pulp.

TABLE II.—*Imports of Canned or Bottled Fruit, Preserved without Sugar, in 1930, 1931 and 1932.*

Country whence consigned.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.
<i>Apricots and apricot pulp—</i>			
Spain	111·4	125·9	121·3
Russia	0·2	3·4	—
United States	2·3	1·8	0·6
Italy	1·9	1·4	0·3
Belgium	0·2	1·0	—
Austria	2·8	—	—
Other countries	1·9	1·0	2·7
Total	120·7	134·5	124·9
<i>Other sorts—</i>			
Canada	3·2	16·6	25·1
Australia	8·1	1·1	15·2
Straits Settlements	1·5	0·9	1·5
Other Empire countries	1·2	0·5	2·1
United States.. .. .	130·2	151·2	158·0
Netherlands	13·6	17·1	8·1
France	12·5	11·0	13·6
Russia	10·4	9·5	6·0
Belgium	7·9	6·2	2·4
Spain	7·7	5·9	25·0
Italy	3·7	0·1	2·2
Other Foreign countries	3·1	2·7	1·0
Total	203·1	222·8	260·2

For 1930, 1931 and 1932 particulars of imports of fruit preserved without sugar, canned or bottled, have been sub-divided into two classes, namely, "Apricots and Apricot Pulp" and "Other sorts." Details of the countries of consignment for these two classes in 1930, 1931 and 1932 are given in Table II. The table shows that about one-third of the imports detailed in Table I consist of apricots and apricot pulp, and that the bulk of the imports of the canned and bottled fruit of this type from Spain are apricots and apricot pulp. It is noticeable, however, that imports from Spain of fruit other than apricot pulp registered a sharp increase in 1932. Apricot pulp is not of material importance in the imports from any country except Spain.

Imports of apricots and apricot pulp, preserved without sugar, occur throughout the year, but with the largest quantities recorded from July to October, immediately after the Spanish apricot harvest. Thus in 1931, over one-half and in 1932, over three-quarters of the imports were recorded in those four months. Moreover the months of July and August alone accounted for one-third of the total in 1931, and over one-half in 1932. The figures are shown in Table III.

TABLE III.—*Monthly Imports of Apricots and Apricot Pulp, Preserved without Sugar (Canned or Bottled)*

Month.	1931.			1932.		
	Spain.	Other Countries.	Total.	Spain.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	5.5	0.8	6.3	0.9	—	0.9
February	1.8	0.1	1.9	5.2	0.4	5.6
March	6.2	0.1	6.3	3.5	1.0	4.5
April	7.3	0.1	7.4	0.9	0.4	1.3
May	12.1	0.5	12.6	0.8	0.6	1.4
June	9.6	0.4	10.0	3.2	0.2	3.4
July	19.8	0.9	20.7	26.3	—	26.3
August	20.9	1.4	22.3	38.1	0.4	38.5
September	7.1	1.2	8.3	17.8	—	17.8
October	16.8	1.2	18.0	13.5	0.5	14.0
November	10.3	1.2	11.5	9.1	—	9.1
December	8.5	0.7	9.2	2.0	0.1	2.1
Total	125.9	8.6	134.5	121.3	3.6	124.9

The main seasons of imports of canned fruit (without sugar), other than apricots, indicate to some extent the variety of the fruit. Imports from Canada and the United States, consisting largely of canned apples, are at their heaviest after the apple harvest is finished, from November or December to April or May. On the other hand imports from the Continent, consisting mainly of soft fruit pulp, are heaviest in the late summer and autumn, although these, like the supplies from the United States, are spread throughout the year. Table IV below shows the seasonal trend of imports during the past two years.

TABLE IV.—*Monthly Imports of Fruit, preserved without sugar, other than Apricots and Apricot Pulp (Canned or Bottled)*

Month.	Canada.	Other Empire Countries.	United States.	France.	Netherlands.	Russia.	Other Foreign Countries.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
1931.								
January	1.1	—	20.6	1.3	1.0	1.6	0.8	26.4
February	0.9	0.5	11.8	0.4	2.1	—	1.0	16.7
March	0.5	0.6	7.8	0.2	1.1	4.4	0.9	15.5
April	0.6	0.2	13.8	0.6	0.3	1.0	0.9	17.4
May	2.0	0.1	7.0	0.6	0.6	—	0.6	10.9
June	1.0	0.1	11.7	0.5	0.3	—	1.1	14.7
July	0.7	0.3	15.9	0.7	1.8	0.5	1.4	21.3
August	0.5	0.1	8.7	1.7	0.8	—	1.3	13.1
September	0.3	0.2	4.3	1.2	1.5	2.0	1.1	10.6
October	0.1	0.1	3.4	2.7	3.3	—	1.4	11.0
November	4.9	0.3	7.9	0.8	3.0	—	2.7	19.6
December	4.0	—	38.3	0.3	1.3	—	1.7	45.6
Total	16.6	2.5	151.2	11.0	17.1	9.5	14.9	222.8
1932.								
January	1.7	0.7	16.9	0.1	—	3.7	1.3	24.4
February	0.8	0.8	10.8	0.2	1.4	0.9	1.9	16.8
March	2.4	2.9	10.0	0.2	0.9	—	2.6	19.0
April	0.5	3.8	19.7	0.1	1.0	0.9	1.1	27.1
May	1.1	3.9	9.4	0.1	0.1	—	0.9	15.5
June	0.2	2.1	6.9	0.1	0.9	—	1.1	11.3
July	0.5	1.9	4.7	0.8	1.3	—	10.2	19.4
August	0.1	0.7	4.2	4.3	1.2	—	0.9	11.4
September	—	0.7	2.8	4.8	0.5	—	3.8	12.6
October	0.3	0.4	10.8	1.8	0.2	—	3.0	16.5
November	7.4	0.7	17.7	0.7	0.3	0.3	1.6	28.7
December	10.1	0.2	44.3	0.4	0.3	0.3	1.9	57.5
Total	25.1	18.8	158.2	13.6	8.1	6.1	30.3	260.2

Imports of fruit, preserved without sugar, not canned or bottled, from the chief consigning countries during the last six years, are shown in Table V.

TABLE V.—*Imports of Fruit, preserved without sugar (not Canned or Bottled)*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
India	1.1	4.1	3.8	3.8	4.6	4.4
Australia	2.8	3.1	1.1	—	0.2	3.0
Other Empire Countries ..	1.5	1.4	2.1	3.3	2.3	6.2
Netherlands	283.6	385.8	244.7	240.6	412.1	312.8
Italy	216.5	215.5	235.1	220.0	167.9	204.1
Russia	—	1.2	44.8	34.7	55.1	4.5
Spain	46.0	24.8	22.5	27.1	20.1	35.7
France	24.1	16.8	20.8	18.9	19.3	51.5
Crete	5.7	3.6	3.4	6.0	3.4	3.0
Greece	4.0	1.4	3.2	3.9	2.6	3.4
United States	6.0	11.6	5.7	0.5	1.1	3.1
Other Foreign Countries	10.8	24.0	18.8	13.4	17.8	7.9
Total Empire Countries	5.4	8.6	7.0	7.1	7.1	13.6
Total Foreign Countries	596.7	684.7	599.0	565.1	699.4	626.0
Total	602.1	693.3	606.0	572.2	706.5	639.6

Following the high total of 706,000 cwts. in 1931, there was a decline in imports of fruit, not canned or bottled, in 1932 to 640,000 cwts., which was slightly more than the average of 636,000 cwts. for the previous five years. The supplies were maintained at this relatively high figure in spite of a reduction of nearly 100,000 cwts. in shipments from the Netherlands. Partial compensation for this decline was, however, found in increased consignments from Italy, the low 1931 total of 168,000 cwts. rising to the more normal figure of 204,000 cwts. in 1932. Over 80 per cent. of the total imports (not canned) thus came from two countries, the Netherlands and Italy. Empire countries contributed 2 per cent. only of the total. Shipments from Australia (mostly black currants) increased sharply while supplies from Canada rose from 696 cwts. in 1931 to 3,680 cwts. in 1932.

In Table VI imports of certain classes of fruit, not canned or bottled, which are included in Table V, have been further classified for the year 1932, but as separate figures are available only for that year, comparable figures for previous years cannot be given.

TABLE VI.—*Imports of Strawberries, Black Currants and Unclassified Fruits, preserved without sugar, other than Canned or Bottled, in 1932*

Country whence consigned.	Strawberries.	Black Currants.	Other Sorts.	Total.
	Cwts.	Cwts.	Cwts.	Cwts.
Australia	—	2,015	985	3,000
Irish Free State	—	—	1,577	1,577
British India	—	—	4,397	4,397
Canada	—	—	3,680	3,680
Union of South Africa	—	—	746	746
Other Empire Countries	—	—	245	245
Belgium	477	2,762	2,634	5,873
Crete	—	—	2,979	2,979
Greece	—	—	3,358	3,358
Germany	937	605	124	1,666
Netherlands	160,322	35,125	117,400	312,847
Italy	110	—	203,973	204,083
France	3,813	31,323	16,337	51,473
Russia	—	2,743	1,720	4,463
Spain	100	25	35,551	35,676
United States	—	38	3,017	3,055
Other Foreign Countries	60	15	394	469
Total	165,819	74,651	399,117	639,587

Imports from Italy, Spain, Crete and Greece consist mainly of citrus products—orange and lemon peel in brine from Italy, orange pulp from Spain and citron peel in brine from Greece and Crete—although some soft fruit pulp is also included. The imports from Italy, Spain and Greece in 1932 were much greater than in the previous year, but those from Crete declined.

The imports from the remaining countries consist mainly of fruit pulp. Holland, which is by far the most important supplier, is dealt with in the next paragraph. Following substantial supplies in each of the previous three years, imports from Russia in 1932 fell to the small total of 4,500 cwts., comparing with 55,000 cwts. in 1931 ; more than half of the 1932 total consisted of black currant pulp. Other countries supplying soft fruit pulp were France, Belgium and Germany, and of these the two latter countries showed a decline in shipments. Supplies from France, however, advanced sharply from some 20,000 cwts. in each of the previous five years to 51,000 cwts. in 1932. Over 60 per cent. of the consignments from France in 1932 were black currants.

The Netherlands accounts for about 80 per cent. of the imports other than those believed to be citrus fruit products, and out of a total of 313,000 cwts. imported in 1932 from that country, 160,000 cwts. were recorded as strawberries, 35,000 cwts. as black currants and 117,000 cwts. as other sorts. An examination of the Dutch export returns shows that these " other sorts " consist mainly of raspberry pulp and gooseberry pulp with smaller quantities of plum and red currant pulp. But there are disparities in the figures, which suggest that the United Kingdom provisional figures for " other sorts " may include some strawberry and black currant pulp. If the Netherlands trade returns are accurate the United Kingdom imports of strawberry and black currant pulp are understated by 20 to 25 per cent.

Particulars of recorded exports to the United Kingdom from Holland of both fruit and fruit pulp in the past six years are shown in Table VII. The figures are gross weights, and thus overstate the exports by about 10 per cent.

About 60 per cent. of the exports of pulp from Holland to the United Kingdom in 1932 consisted of strawberry pulp, this being much the same proportion as in the previous two years, but appreciably higher than in other years. Though substantially lower than the very high total for 1931, the volume of shipments of strawberry pulp was much greater than in other recent years. Exports of black currant pulp and gooseberry pulp declined sharply and exports of plum pulp were the lowest since 1926, but raspberry pulp increased slightly.

TABLE VII.—*Exports of Fruit and Fruit Pulp from the Netherlands to the United Kingdom*

Raw Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apples	28·3	2·0	37·6	1·2	71·5	(a)
Pears	19·7	21·3	19·3	6·6	11·8	8·5
Cherries	4·5	5·3	13·4	6·7	4·5	2·2
Plums	12·7	11·2	12·3	1·7	6·9	7·3
Black currants ..	17·1	7·9	11·5	20·0	20·2	3·1
Red currants ..	8·4	9·8	8·8	9·7	8·4	(a)
Gooseberries ..	38·5	15·5	9·6	21·5	12·6	9·3
Strawberries ..	29·3	23·9	22·2	34·6	35·8	24·6
Raspberries ..	0·1	—	—	—	—	(a)
Fruit Pulp.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apple	5·8	1·9	1·8	—	—	—
Pear	—	—	—	—	—	—
Cherry	0·4	0·7	0·7	—	—	—
Plum	22·4	27·6	26·9	22·9	13·9	11·8
Black currant ..	50·4	45·3	61·4	44·2	85·0	49·4
Red currant ..	2·8	3·9	3·6	(a)	(a)	(a)
Gooseberry ..	39·0	35·5	25·7	24·7	38·6	26·3
Strawberry ..	151·2	171·1	132·6	151·6	274·2	225·3
Raspberry ..	61·4	41·8	34·6	28·0	48·0	53·2

(a) Not available.

The seasons of maximum imports of fruit, preserved without sugar, not canned, are very clearly shown in Tables VIII and IX, which give separate particulars of the monthly imports of strawberries, black currants, and "other sorts" for the year 1932. Imports from Holland are heaviest during July and August following the harvest of the soft fruits, while imports from Italy are heaviest during the first six months of the year and thus reflect the citrus fruit season.

TABLE VIII.—*Monthly Imports of Strawberries and Black Currants preserved without sugar (not Canned or Bottled) in 1932*

Month.	Strawberries.				Black Currants.			
	Nether-lands.	France.	Other Coun-tries.	Total.	Nether-lands.	France.	Other Coun-tries.	Total.
	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.	Thou-sand cwts.
January	3.4	—	—	3.4	1.0	0.1	0.3	1.4
February	6.1	0.1	0.3	6.5	2.5	—	1.0	3.5
March	0.9	—	0.6	1.5	0.1	—	0.1	0.2
April	10.6	—	—	10.6	0.2	0.1	0.4	0.7
May	0.5	0.2	—	0.7	0.2	—	0.5	0.7
June	10.1	1.8	—	11.9	0.3	0.2	—	0.5
July	83.4	0.6	0.6	84.6	7.6	3.6	0.8	12.0
August	18.4	1.1	—	19.5	8.7	14.6	1.1	24.4
September	7.8	—	—	7.8	5.4	10.0	0.3	15.7
October	7.3	—	—	7.3	5.9	2.4	1.3	9.6
November	3.9	—	0.2	4.1	1.3	0.1	2.5	3.9
December	7.9	—	—	7.9	1.9	0.2	—	2.1
Total	160.3	3.8	1.7	165.8	35.1	31.3	8.3	74.7

TABLE IX.—*Monthly Imports of Fruit, other than Strawberries and Black Currants, preserved without sugar (not Canned or Bottled) in 1932.*

Month.	Italy.	Nether-lands.	Spain.	France.	Other countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January ..	1.8	7.4	0.5	0.6	2.5	12.8
February ..	20.9	16.4	3.1	1.0	2.4	43.8
March ..	34.8	2.4	2.1	0.1	1.6	41.0
April ..	45.2	8.2	1.2	0.5	2.3	57.4
May ..	30.7	0.1	4.4	0.1	1.0	36.3
June ..	32.0	3.7	0.7	0.3	1.9	38.6
July ..	9.9	26.6	5.4	6.7	2.3	50.9
August ..	3.7	17.0	6.2	2.4	2.3	31.6
September ..	5.4	16.0	6.6	1.8	3.1	32.9
October ..	7.6	8.2	1.2	1.3	1.2	19.5
November ..	3.6	6.2	3.2	1.0	1.9	15.9
December ..	8.4	5.2	1.0	0.5	3.3	18.4
Total ..	204.0	117.4	35.6	16.3	25.8	399.1

IMPORTS OF ONIONS

Between the years 1924 and 1931 the area of onions harvested ripe in England and Wales consistently declined from 1,880 acres to 740 acres, and production from 12,000 to 4,200 tons, but the decline was checked in 1932, the acreage in that year being extended to 924 acres and production increased to 5,400 tons. In the period 1924-1932 the Scottish onion acreage declined from 161 to 132, and although production figures in Scotland are not published annually, the aggregate output of onions for the whole of Great Britain can be set at about 6,000 tons in 1932 as against about 13,000 tons in 1924.

In contrast with this output, imports of onions into the United Kingdom (reckoning 50 bushels to the ton) have averaged over 200,000 tons annually during the past six years, and it is probable that for no other agricultural product, grown in this country, is the British market so dependent upon imported supplies. Moreover, almost the whole of the imports are obtained from foreign sources.

In Table I are shown imports from the chief countries of consignment during the past six years.

TABLE I.—Imports of Onions into the United Kingdom, 1927-32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand bushels.	Thou- sand bushels.	Thou- sand bushels.	Thou- sand bushels.	Thou- sand bushels.	Thou- sand bushels.
Spain	4,518	4,255	4,526	5,127	4,609	4,782
Netherlands	2,507	2,459	2,981	3,247	3,109	2,503
Egypt	1,802	2,734	2,438	1,657	1,821	2,135
France	571	376	400	434	370	144
Germany	55	55	67	218	171	210
Portugal	101	58	86	21	17	12
Belgium	112	55	63	42	35	45
Argentina.. .. .	—	2	—	(a)	—	58
Other Foreign Countries..	192	144	115	25	24	67
Total Foreign Countries..	9,858	10,138	10,676	10,771	10,156	9,956
Total Empire Countries..	37	17	10	13	15	39
Total	9,895	10,155	10,686	10,784	10,171	9,995

(a) Less than 500 bushels.

Imports from the three chief sources fluctuate individually, but in the aggregate account for well over 90 per cent. of imported supplies. There was no change in the order of importance of these three countries in 1932, but Spain's share of the total imports increased from 46 to 48 per cent., while the Netherland's contribution dropped from 31 to 25 per cent. Egypt accounted for 21 per cent. of the total as compared with 18 per cent. in 1931.

In spite of a reported good Finistère crop, imports of French onions declined substantially as compared with previous years; the total imported in 1932 was, in fact, the lowest recorded in post-war years. On the other hand, there was an increase in imports from Germany which were probably to a very large extent the produce of other countries, as Germany itself is a large and increasing importer of onions. A feature of the year was the initiation of shipments of Argentine onions to the United Kingdom market on a commercial scale; imports from that country, which had hitherto been of little or no importance, amounted in 1932 to 58,000 bushels. Imports from Hungary and Italy were also considerably larger than in previous years; from a modest 1,000 bushels in 1931 imports from Hungary increased to 26,000 bushels in 1932, and the total from Italy advanced from 11,000 bushels to 19,000 bushels in the same years. Malta was mainly responsible for the increase in imports from Empire sources in 1932, and accounted for 34,000 bushels of the total, the Channel Islands and Cyprus contributing about 2,000 bushels each. United Kingdom statistics show very little or no imports of onions from Cyprus, but according to Cyprus trade returns exports of onions from that country to the United Kingdom totalled about 61,000 bushels in 1930, 65,000 bushels in 1931 and 58,000 bushels in 1932. As these onions are transhipped at Port Said en route, it would appear that the greater part must have been classed by importers as Egyptian onions on arrival in the United Kingdom and included in the figures of imports from Egypt.

Onions are imported throughout the year, but there occurs a period of maximum imports during autumn when Spanish and Dutch supplies reach their height. There is usually another high peak in either April or May when Egyptian supplies dominate the market. Table II shows imports by months during the past six years, and Table III gives imports from the main sources during each month of 1932.

TABLE II.—Imports of Onions into the United Kingdom in each Month, 1927-32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand bushels.	Thousand bushels.	Thousand bushels.	Thousand bushels.	Thousand bushels.	Thousand bushels.
January	936	954	1,034	1,099	982	949
February	951	743	650	982	851	673
March	675	596	932	834	987	623
April	787	1,295	1,210	798	756	641
May	953	1,151	772	771	595	838
June	370	453	388	509	625	495
July	522	464	540	493	619	771
August	892	871	846	1,074	778	911
September.. ..	684	753	998	798	1,093	1,008
October	1,401	1,134	1,331	1,288	1,104	1,282
November.. ..	962	840	1,172	1,054	962	863
December	762	901	813	1,084	819	941
Total.. ..	9,895	10,155	10,686	10,784	10,171	9,995

TABLE III.—Imports of Onions into the United Kingdom in each Month of 1932, showing Countries whence consigned.

Month.	Spain.	Nether-lands.	Egypt.	France.	Germany	Argen-tina.	Other Countries.	Total.
	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.	Thou-sand bushels.
January	476	454	6	3	6	—	4	949
February	313	295	48	3	8	3	3	673
March	188	175	248	(a)	2	7	3	623
April	21	26	592	(a)	—	(a)	2	641
May	91	28	707	(a)	1	9	2	838
June.. ..	172	27	264	(a)	—	24	8	495
July.. ..	423	35	242	13	—	15	43	771
August	587	186	22	94	4	—	18	911
September	560	381	—	23	27	—	17	1,008
October	811	394	—	3	60	—	14	1,282
November	539	268	3	(a)	33	—	20	863
December	601	234	3	5	69	—	29	941
Total	4,782	2,503	2,135	144	210	58	163	9,995

(a) Less than 500 bushels.

The main Spanish onion season opens in July, reaches its height about October, and runs until May, when the *babosas* (summer onions) come into the market for a short period. The Dutch season is much the same as the Spanish, opening in July, reaching its peak in September or October, and tailing off to negligible proportions in May and June, while the French season is somewhat similar, although the peak of the season occurs earlier, in August. Egyptian new crop onions usually begin to arrive in March, reach their peak in April or May, and by the end of July are about finished. Supplies from Argentina begin to arrive in February, and reach their height in June.

IMPORTS OF POTATOES

Imports of potatoes fluctuate from year to year according to the size of the home crop. Only supplies of early potatoes remain fairly constant. United Kingdom production of potatoes in 1930 was only 4,459,000 tons, or 858,000 tons below the 1925-29 average. But the 1931 crop fell still further to 3,857,000 tons. These two light harvests led to an enormous temporary expansion in imports, but the 1932 crop, at 5,576,000 tons, was 260,000 tons above the 1925-29 average, and imports during the latter part of 1932 were accordingly down to normal dimensions again.

Imports by calendar years do not adequately reflect the import position, as large imports resulting from a light crop in Great Britain are spread over parts of the two calendar years. Thus the heavy imports of old potatoes in the latter months of 1931, rendered necessary by the short home crop, continued unchecked throughout the first half of the following year, and were augmented by unusually large supplies of Spanish new crop potatoes. With the harvesting of the good 1932 home crop the improvement in the supply position immediately manifested itself, and from August onwards imports fell off drastically. But the heavy imports in the earlier months of the year caused total imports for 1932 to fall little short of the record 1931 total.

Table I shows imports of potatoes during the past six years.

TABLE I.—Imports of Potatoes into the United Kingdom, 1927-32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Irish Free State	569	913	370	214	781	597
Channel Islands	854	1,021	1,286	1,033	911	1,011
Malta and Gozo	18	15	5	(a)	14	26
Other Empire Countries..	(a)	7	—	(a)	2	50
Estonia	55	—	—	(a)	108	178
Norway	30	—	1	—	101	239
Denmark .. .. .	.2	1	—	1	390	539
Poland (including Dantzig)	6	35	—	—	375	120
Germany	26	818	4	268	4,602	2,213
Netherlands	564	1,054	430	911	3,509	4,343
Belgium	28	442	22	25	1,882	2,368
France	2,760	3,865	2,510	2,208	2,142	78
Algeria	17	24	17	16	1	(a)
Spain	749	986	1,041	939	1,546	3,192
Canary Islands	95	265	171	151	224	251
Italy	31	66	4	12	25	88
Other Foreign Countries..	28	10	8	3	40	266
Total Empire Countries..	1,441	1,956	1,661	1,247	1,708	1,684
Total Foreign Countries..	4,391	7,565	4,208	4,534	14,945	13,875
Total	5,832	9,521	5,869	5,781	16,653	15,559

(a) Less than 500 cwts.

Imports in the first six months of 1932 were heavier than ever before recorded in that period of the year. Imports from Germany, which had been unusually heavy during the last three months of 1931, were on a somewhat lighter scale in the new year so that total imports in 1932 showed a substantial decline from the 1931 record level, but imports of Dutch potatoes continued into the new year on an even larger scale than in 1931, and total imports from Holland in 1932 were the highest ever recorded from that country. In fact, imports from a whole range of European countries, including Spain, Belgium, Denmark, Norway and Italy, established records in 1932. Imports from Spain were nearly twice as heavy as in the

previous years, but there was a drastic reduction in French supplies as a result of the operations of the Colorado Beetle order.

Table II shows imports by months during the past six years.

TABLE II.—*Imports of Potatoes into the United Kingdom in each Month, 1927-32.*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January	171	215	61	36	449	3,044
February	134	195	54	27	585	1,588
March	160	543	136	80	543	1,286
April	240	1,447	185	163	1,342	1,969
May	1,363	1,816	868	974	1,958	2,346
June	2,160	3,580	2,279	2,428	2,900	2,851
July	863	1,177	1,571	987	1,489	1,744
August	138	321	332	204	336	321
September.. ..	34	75	138	66	761	104
October	183	28	87	272	1,833	97
November.. ..	186	69	93	245	2,823	139
December.. ..	200	55	65	299	1,634	70
Total	5,832	9,521	5,860	5,781	16,653	15,559

Table III shows monthly imports during 1932 from the principal countries of consignment, together with figures for the first three months of 1933. In marked contrast with the position in the previous year, very little was imported from Germany in the second half of 1932, and much reduced quantities from the Netherlands. The Spanish season is of short duration, the bulk of the imports falling in May or June, and either of these months may be the peak point according to the earliness or lateness of the season. The Canary Islands season starts earlier but usually continues as long as the Spanish season lasts, while imports fluctuate far less than in the case of those from Spain. Imports of new crop Channel Islands potatoes begin in May, and the bulk of the crop is imported in June.

TABLE III.—Imports of Potatoes during each Month of 1932, and from January to March, 1933, showing Countries whence consigned.

Month.	Germany.	Nether-lands.	France.	Spain.	Canary Islands.	Channel Islands.	Other Countries.	Total.
1932	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January..	469	1,212	44	—	1	(a)	1,318	3,044
February	547	504	29	—	(a)	1	507	1,588
March ..	312	404	5	16	23	1	525	1,286
April ..	561	555	—	134	66	1	712	1,969
May ..	275	342	—	1,278	59	16	376	2,346
June ..	66	390	—	1,317	54	746	278	2,851
July ..	41	543	—	449	48	237	428	1,744
August ..	1	158	—	—	—	9	153	321
September	1	58	—	—	—	—	45	104
October..	(a)	56	—	—	—	—	41	97
November	—	60	—	—	—	—	79	139
December	—	61	—	—	(a)	—	9	70
Total, 1932	2,213	4,343	78	3,192	251	1,011	4,471	15,559
1933								
January..	—	67	—	—	(a)	(a)	18	85
February	—	46	—	(a)	1	1	17	65
March ..	—	41	—	29	27	1	29	127

(a) Less than 500 cwts.

IMPORTS OF TOMATOES

Imports of raw tomatoes, after showing a fairly consistent rise in post-war years to a level of about 3,000,000 cwts. in 1930 and 1931, fell back in 1932 to 2,442,000 cwts., a figure little above the 1927 total. The decline was due to decreased imports from both the Canary Islands and Holland, which were the lowest recorded in each case since 1927. There was also a drastic reduction in imports from Spain owing to the Valencia exporting season being practically a failure. On the other hand, imports from the Channel Islands made the usual recovery which appears to occur in alternate years. Table I shows imports during the past six years.

TABLE I.—Imports of Tomatoes into the United Kingdom, 1927–32.

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Channel Islands ..	652	870	741	863	768	829
Other Empire Coun- tries	5	(a)	(a)	2	(a)	(a)
Netherlands ..	444	492	611	665	731	467
France	54	77	39	27	21	(a)
Spain	155	150	114	89	92	11
Canary Islands ..	995	1,199	1,218	1,394	1,295	1,127
Italy	16	7	17	5	5	5
Other Foreign Coun- tries	11	10	12	7	24	3
Total Empire Countries ..	657	870	741	865	768	829
Total Foreign Countries ..	1,675	1,935	2,011	2,187	2,168	1,613
Total ..	2,332	2,805	2,752	3,052	2,936	2,442

(a) Less than 500 cwts.

As indicated in the foregoing table, the Channel Islands, Canary Islands and the Netherlands together account for the bulk of the imports, supplies from other sources in 1932 being practically negligible and the Empire contribution to imports, represented almost entirely by the Channel Islands, was about 34 per cent. of the total. Production of tomatoes under glass in England and Wales increased from 940,000 cwts. in 1925 to 1,080,000 cwts. in 1931, the latest year for which figures are available.

Imports of tomatoes are usually at their greatest between May and October, which is precisely the season when home-grown supplies are at their height. During these six months practically two-thirds of the imports are registered. In Table II are shown imports by months during the past six years and in Table III monthly imports from the principal countries of consignment during 1932.

TABLE II.—Imports of Tomatoes into the United Kingdom in each Month, 1927–32.

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	106	103	164	143	124	113
February	120	118	151	131	136	126
March	177	152	160	184	135	115
April	171	211	209	230	234	124
May	206	290	237	365	300	264
June	261	312	256	361	355	306
July	304	286	319	364	353	303
August	251	326	311	366	345	305
September ..	259	421	408	348	323	306
October	223	287	224	285	265	158
November ..	123	174	179	133	205	150
December ..	131	125	133	142	161	172
Total ..	2,332	2,805	2,751	3,052	2,936	2,442

TABLE III.—Imports of Tomatoes in each Month of 1932, showing Countries whence consigned.

Month.	Channel Islands.	Nether- lands.	Italy.	Spain.	Canary Islands.	Other Coun- tries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	(a)	—	—	(a)	113	—	113
February	(a)	(a)	(a)	(a)	126	—	126
March ..	(a)	(a)	1	(a)	114	—	115
April ..	3	(a)	1	(a)	120	—	124
May ..	70	21	1	2	169	1	264
June ..	144	73	1	3	85	—	306
July ..	130	84	(a)	1	87	1	303
August ..	117	177	—	1	10	—	305
September	220	85	—	1	—	—	306
October	129	22	—	—	7	—	158
November	16	5	1	2	125	1	150
December	(a)	(a)	(a)	1	171	—	172
Total..	829	467	5	11	1,127	3	2,442

(a) Less than 500 cwts.

The Canary Islands are almost the only source of supply of imported tomatoes during the winter months. The season opens in October, when the main continental supplies are finishing, and runs through to June or July, overlapping the Channel Islands and Dutch seasons, which start about May and June respectively and continue into October.

IMPORTS OF MISCELLANEOUS FRESH VEGETABLES

Potatoes, onions, and tomatoes are the only raw vegetables separately distinguished in the United Kingdom trade returns, and are by far the most important vegetables imported. The average value of imports of potatoes, during the five years 1928 to 1932 amounted to £4,728,000 per annum, of onions to £1,984,000 per annum, and of tomatoes to £4,418,000 per annum. The declared value of imports of all other raw vegetables amounted to £1,060,000 in 1932, but averaged over £1,600,000 during the previous five years. No information is available as to the volume of imports of miscellaneous vegetables.

France and the Netherlands provide much the greatest proportion of the miscellaneous vegetables imported, these two countries together accounting for over 80 per cent. of total imports by value. The value of the imports from Holland in 1932 showed little variation from that in previous years, but there was a substantial fall in the value of the imports from France, which was little more than a third of that of 1931. As shown in Table II exports of all kinds of miscellaneous vegetables from France last year to this country showed heavy declines. The value of imports from Italy also declined sharply, which was probably in a large measure due to the substantial reduction in exports of Italian cauliflowers to this country, which, according to special returns received by the Board declined, from 4,700 tons in 1931 to under 500 tons in 1932. There appears to have been a considerable increase in the value of the imports from Spain, although comparative figures for previous years are not separately distinguished, which tends to confirm the reports of a large expansion in the exports of Spanish salads to this country for which statistics, official or otherwise, are also unavailable.

Imports by value in the six years 1927 to 1932 are shown in Table I.

TABLE I.—Imports of Raw Vegetables (other than Potatoes, Onions and Tomatoes) into the United Kingdom, 1927–32.

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	£000.	£000.	£000.	£000.	£000.	£000.
France	924	800	864	965	905	328
Netherlands	438	603	521	582	540	551
Germany	27	28	34	34	26	33
Madeira	27	47	41	30	37	28
Belgium	22	24	23	30	34	22
Italy	7	18	18	17	89	15
Spain	(b)	(b)	(b)	(b)	(b)	26
Other Foreign Countries..	7	13	18	11	13	12
Channel Islands	56	27	47	40	45	41
Irish Free State	3	4	7	2	2	4
Other Empire Countries	(a)	(a)	3	2	(a)	(a)
Total	1,511	1,564	1,576	1,713	1,691	1,060

(a) Less than £500. (b) If any, included in "Other Foreign Countries."

Although no figures are available from British trade returns as to the volume of the various vegetables going to make up the totals shown in the above table, it is possible to get some indication of the relative proportions from the export returns of the chief foreign countries of supply. The figures throughout are gross weights; net weights are about 10 per cent. less.

TABLE II.—Exports of Raw Vegetables (other than Potatoes, Onions and Tomatoes) from France.

Description.	1931.				1932.			
	United Kingdom.	Germany.	Switzerland.	Total Exports.	United Kingdom.	Germany.	Switzerland.	Total Exports.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
Asparagus	1,680	380	980	3,100	495	—	955	1,490
Cauliflowers	33,290	5,720	3,390	50,440	12,325	3,895	2,780	25,025
Salads	3,580	6,340	5,200	16,620	1,885	1,875	5,065	9,990
Artichokes				220				170
French beans	(a)	(a)	(a)	2,040	(a)	(a)	(a)	1,445
Green Peas .. .. .									2,100	1,140
Other descriptions	3,060	7,780	5,750	19,490	975	1,820	5,695	10,140
Total	(a)	(a)	(a)	94,010	(a)	(a)	(a)	49,400

(a) Figures not yet available. The distribution of exports in 1930 was:—(tons)— Artichokes, United Kingdom 26, Germany 65, Switzerland 136, total 320; French beans, United Kingdom 60, Germany 1,485, Switzerland 641, total 2,860; Green peas, United Kingdom, 1,877, Germany 130, Switzerland 480, total 2,820.

Table II shows exports of raw vegetables (other than potatoes, onions and tomatoes) from France, distinguishing the three principal countries of consignment, viz. :—the United Kingdom, Germany and Switzerland, in 1931 and 1932.

Total exports of miscellaneous raw vegetables from France last year declined by nearly 50 per cent., and although the complete figures are not yet available, exports to the United Kingdom clearly declined to a very much larger extent. The figures in the above table show that cauliflowers form the bulk of the imports of unclassified fresh vegetables into this country from France, followed by salads, green peas and asparagus.

Table III shows exports of raw vegetables (other than potatoes, onions and tomatoes) from the Netherlands, distinguishing the two principal countries of consignment, viz. :—the United Kingdom and Germany, in 1931 and 1932.

TABLE III.—*Exports of Raw Vegetables (other than Potatoes, Onions and Tomatoes) from the Netherlands.*

Description.	1931.			1932.		
	United Kingdom.	Germany.	Total Exports.	United Kingdom.	Germany.	Total Exports.
	tons.	tons.	tons.	tons.	tons.	tons.
White and savoy cabbage	160	16,380	39,240	(a)	26,190	48,130
Red cabbage	2,560	16,200	27,700	2,190	19,200	30,270
Cauliflowers	4,190	23,590	35,590	2,130	11,930	19,720
Brussels sprouts	515	3,610	6,380	(a)	3,630	5,370
Salads	9,540	18,300	31,000	8,940	16,840	32,240
Carrots	17,390	5,140	36,530	14,360	2,155	26,940
Turnips	85	960	1,240	(a)	(a)	1,050
Cucumbers	2,750	41,920	45,930	1,145	33,420	35,770
Gherkins	950	3,590	4,600	740	5,755	6,740
Green peas	—	450	4,840	—	255	1,870
Beans	—	3,790	3,940	—	6,140	6,810
Other descriptions	1,070	6,430	11,820	2,335	4,800	12,340
Total	39,210	140,360	248,810	(a)	(a)	227,250

(a) Figures not yet available.

Exports of miscellaneous raw vegetables from the Netherlands, which in 1931 showed a heavy decline in comparison with the previous year, fell again, but not so steeply, in 1932. Germany continues to take by far the largest share of the total exports. Over 60 per cent. of the total went to that country in 1932, as compared

with about 15 per cent. to the United Kingdom. Belgium comes next in order of importance and the bulk of the exports of green peas go to that country, as well as substantial quantities of carrots.

The figures in the above table indicate that carrots and salads form a very considerable proportion of the volume of imports of unclassified fresh vegetables into the United Kingdom from the Netherlands. Together, they accounted for about two-thirds of the total exports to this country in 1931 and 1932.

As previously stated France and the Netherlands account for about 85 per cent. of the imports of miscellaneous vegetables into the United Kingdom. Included in imports from other countries are beans, green peas, broccoli, and radishes from the Channel Islands; cauliflowers, green peas and asparagus from Italy; cauliflowers and chicory from Belgium; salads, artichokes and green peas from Spain; and beans, carrots and vegetable marrows from Madeira. No figures are available in regard to the actual quantities.

In Table IV are shown exports of raw vegetables (other than potatoes, onions and tomatoes) from France and the Netherlands to the United Kingdom during each month of 1932.

TABLE IV.—*Exports of Raw Vegetables from France and the Netherlands to the United Kingdom in each month of 1932.*

Month.	Salads.		Cauliflowers.		Carrots.	Cucumbers.	Asparagus.	Green Peas (a).
	France.	Netherlands.	France.	Netherlands.	Netherlands.	Netherlands.	France.	France.
	tons.	tons.	tons.	tons.	tons.	tons.	tons.	tons.
January	485	—	3,845	—	2,610	—	4	—
February	450	—	1,835	—	1,760	—	2	1
March	601	326	1,800	—	2,880	202	22	4
April	220	2,790	2,600	—	944	210	84	5
May	37	4,052	2,080	46	457	53	233	96
June	14	1,404	—	1,146	1,752	266	133	733
July	4	34	—	750	905	232	15	280
August	3	19	—	113	967	133	—	11
September	2	11	—	4	987	41	—	4
October	2	6	—	61	542	8	—	3
November	4	110	70	7	260	—	1	3
December	63	188	95	3	296	—	1	—
Total	1,885	8,940	12,325	2,130	14,360	1,145	495	1,140

(a) Total to all destinations. Exports to the United Kingdom in 1930 amounted to 1,877 tons and the total to all destinations 2,820 tons.

IMPORTS OF CUT FLOWERS

Imports of fresh flowers into this country are shown in the trade returns of the United Kingdom under one heading, and by value only. The value of the imports in recent years showed a progressive increase from £410,000 in 1925 to £1,065,000 in 1931, but there was a sharp set back in 1932 to below the 1928 level; the total value of the imports amounted to £611,000, or less than 60 per cent. of the total imports in the previous year. The Channel Islands, the Netherlands and France together provide the bulk of the imported supplies, imports from other countries being negligible. The value of the imports from the Channel Islands which had averaged £160,000 over the previous five years rose in 1932 to a new high level of £213,000, an increase of 20 per cent. over the previous year. On the other hand there were substantial declines in the recorded values of imports from both the Netherlands and France, in each case of about 55 per cent., as compared with 1931. The Empire's contribution of the value of total imports increased from 17 per cent. in 1931 to 36 per cent. in 1932.

In Table I is shown the value of imports of cut flowers into the United Kingdom in each of the past six years.

TABLE I.—*Imports of Cut Flowers into the United Kingdom, 1927-32.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	£000	£000	£000	£000	£000	£000
Channel Islands	150	148	177	149	175	213
Other Empire countries ..	6	4	7	7	8	7
Netherlands	152	284	328	358	540	235
France	285	264	214	247	333	149
Other Foreign countries	3	2	3	4	8	7
Total Empire countries	156	152	184	156	183	220
Total Foreign countries	440	550	545	609	881	391
Total	596	702	729	765	1,064	611

South Africa accounted for the greater proportion of the imports from "Other Empire Countries" in 1932 and in the previous year; the recorded value in 1932 was nearly £6,000, a slight increase as compared with the previous year.

Table II shows the value of imports of cut flowers into this country during each month in 1932 according to countries from which consigned. January was the most important month for both the Netherlands and France and March for the Channel Islands; the peak for imports from each of these countries was one month earlier than in the previous year. As in 1931, the Netherlands accounted for the greater proportion of the imports during the first four months of the year, but from April onwards the main source of supply was the Channel Islands, a striking contrast with 1931 when the Channel Islands did not head the list in one single month.

TABLE II.—*Imports of Cut Flowers into the United Kingdom in 1932.*

Month.	Nether-lands.	France.	Channel Islands.	Other Coun-tries.	Total.
	£	£	£	£	£
January	62,456	40,541	5,766	1,115	109,878
February	61,968	31,492	13,556	509	107,525
March	60,117	23,382	43,040	447	126,986
April	32,992	17,269	28,294	874	79,429
May	4,617	7,470	33,498	324	45,909
June	1,868	1,332	28,483	306	31,989
July	257	102	3,675	192	4,226
August.. .. .	91	109	1,984	265	2,449
September	168	153	1,952	626	2,899
October	1,583	805	2,524	1,667	6,579
November	1,540	1,924	23,231	2,223	28,918
December	7,298	24,521	27,496	5,151	64,466
Total	234,955	149,100	213,499	13,699	611,253

The trade returns of France and the Netherlands do not distinguish exports of different kinds of fresh flowers, but they give certain information regarding total quantities exported. The figures throughout are gross weights, net weights being about 10 per cent. less.

In Table III is shown the distribution of exports from France in each of the past six years.

TABLE III.—*Exports of Cut Flowers from France.*

Exported to	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
United Kingdom ..	3,369	3,224	2,213	3,178	4,269	1,502
Germany	583	348	261	376	242	115
Belgium	141	181	156	217	273	124
Switzerland ..	(a)	353	241	236	236	155
Other Countries ..	180	164	105	119	140	73
Total	4,273	4,270	2,976	4,126	5,160	1,969

(a) Figures not available, included in "Other Countries".

The United Kingdom continues to be the principal market for French cut flowers, and took over 80 per cent. of the exports in 1931 and a slightly less proportion in 1932, but exports to the United Kingdom in 1932 were little more than one-third as heavy as in the previous year. There were declines of over 50 per cent. in exports to each of the other countries of consignment, and total exports in 1932 were the lowest recorded for many years.

TABLE IV.—*Exports of Cut Flowers from the Netherlands.*

Exported to	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
United Kingdom ..	1,030	1,897	2,130	2,074	4,198	1,978
Germany	831	1,236	860	1,106	1,037	1,028
Belgium	(a)	(a)	(a)	46	103	275
France	24	102	239	373	674	141
Switzerland ..	18	51	51	69	105	163
Other Countries ..	91	104	113	145	243	103
Total	1,994	3,390	3,393	3,767	6,257	3,688

Table IV shows the distribution of exports from the Netherlands in each of the past six years. The United Kingdom is the principal market for Dutch as well as for French cut flowers, and in 1931 took nearly 70 per cent. of the total exports from Holland. But in 1932 there was a substantial decline both in exports to the United Kingdom and in the proportion taken by that market, and there

was a sharp setback in total exports from the high level which they reached in the previous year. Germany is a much more important market for Dutch flowers than for French flowers, and there has been a steady development in exports from Holland to other markets in recent years.

As stated above, the volume of exports given in French and Dutch export returns is given in gross weights. Allowing a margin of 10 per cent., the average declared value of imports of cut flowers from Holland was 160s. to 175s. per cwt. (about 1s. 6d. per lb.) from 1927 to 1929, and rose to 192s. (1s. 9d. per lb.) in 1930, when the rapid rise in imports was temporarily checked. There was a fall to 143s. (1s. 3d. per lb.) in 1931, when supplies doubled as compared with the previous year, and a further slight fall last year to 132s. (1s. 2d. per lb.), although there was a 50 per cent. reduction in supplies as compared with 1931. The declared value of imports from France is lower, the average varying from 86s. per cwt. in 1930 to 110s. per cwt. in 1932, or just under 1s. per lb. at the latter rate.

The weight of exports of cut flowers from France and Holland to the United Kingdom, in each month of the past three years, according to French and Dutch trade returns, is shown in Table V.

TABLE V.—*Monthly Exports of Cut Flowers from France and the Netherlands to the United Kingdom.*

Month.	France.			Netherlands.		
	1930.	1931.	1932.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
January	449	556	579	248	708	430
February	836	695	473	456	944	546
March	567	1,061	185	441	845	556
April	372	618	139	259	722	321
May	389	273	30	168	331	44
June	192	186	20	89	157	14
July	60	36	3	89	112	4
August	6	8	4	117	132	2
September.. .. .	3	1	2	17	63	1
October	4	6	7	19	25	16
November	44	188	20	19	34	7
December	256	641	40	152	125	40
Total	3,178	4,269	1,502	2,074	4,198	1,978

IMPORTS OF FLOWER BULBS

Over 90 per cent. of the total imports of flower bulbs into the United Kingdom come from the Netherlands. Of the remainder, the principal countries furnishing supplies are the Channel Islands, France and Japan. Imports of Dutch bulbs showed a further substantial advance last year to a new high level, and the number imported was almost exactly double that recorded six years ago. Imports from other sources show no signs at present of any important expansion, and are insignificant in comparison with the imports from Holland. Table I shows imports into this country during the last six years.

TABLE I.—*Imports of Flower Bulbs into the United Kingdom.*
(Millions of bulbs.)

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
Netherlands	367	393	341	433	551	723
Channel Islands	3	5	10	7	4	7
France	7	6	9	8	6	5
Japan	7	7	6	6	7	8
Other Countries	6	5	10	10	13	7
Total	390	416	376	464	581	750

In spite of the substantially larger number of flower bulbs imported in 1932 as compared with the previous year, the declared value of the imports declined from £1,471,000 to £1,229,000. This was more than twice the recorded value of the imports of cut flowers in 1932.

Table II shows imports from the principal countries during each month of 1932.

The Netherlands tradereturns show exports of flower bulbs by weight. The United Kingdom continues to take a far larger share of the total quantity exported than any other country, but substantial quantities are consigned to the United States, Germany, Canada, France and Scandinavian countries. Table III gives the distribution of total exports from the Netherlands during the last six years. Figures shown are gross weights.

TABLE II.—Imports of Flower Bulbs into the United Kingdom in 1932.

(Thousands of bulbs.)

Month.	Nether-lands.	Channel Islands.	Japan.	France.	Other Coun-tries.	Total.
January	8,100	1	308	1	104	8,514
February	8,796	1	107	50	315	9,269
March	6,058	32	9	—	109	6,208
April	5,175	—	—	—	283	5,458
May	5,786	—	—	—	19	5,805
June	223	—	—	—	16	239
July	3,877	73	—	595	425	4,970
August	182,442	2,060	183	3,735	2,870	191,290
September	353,237	3,690	303	706	1,057	358,993
October	111,504	1,175	2,449	319	518	115,965
November	21,560	29	3,604	1	188	25,382
December	16,304	3	1,436	34	459	18,236
Total.. ..	723,062	7,064	8,399	5,441	6,363	750,329

TABLE III.—Exports of Flower Bulbs from the Netherlands.

Exported to	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
United Kingdom	14,345	15,255	12,155	17,750	21,250	25,205
United States	8,475	8,635	6,385	8,580	6,405	4,772
Germany	6,230	7,795	6,590	7,245	5,731	6,165
Sweden	2,420	2,510	2,090	2,710	2,627	2,278
Denmark	1,925	2,230	1,360	2,230	2,352	1,001
Canada	1,885	1,750	1,400	1,680	1,668	1,715
France	630	795	775	1,200	1,588	2,257
Norway	815	730	655	815	702	533
Other countries	1,945	2,230	2,280	2,590	2,886	2,780
Total	38,670	41,930	33,690	44,800	45,209	46,706

Exports from Holland last year reached a new high record, but while the quantities exported to the United Kingdom and France continue to expand, exports to the United States and Scandinavia

are declining. It is observed that whereas exports by weight from Holland to the United Kingdom in 1932 showed an increase of 20 per cent. over the previous year, imports by number into the United Kingdom from Holland in the same year showed an increase of 30 per cent. over 1931.

Table IV shows exports of flower bulbs by weight from the Netherlands to this country in each month of the past four years.

TABLE IV.—*Monthly Exports of Flower Bulbs from the Netherlands to the United Kingdom.*

Month.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.
January	534	618	685	285
February	169	378	533	371
March	460	415	511	280
April	322	212	328	126
May	122	58	72	21
June	13	2	6	2
July	22	138	90	94
August	2,807	5,675	5,825	8,118
September	5,312	6,875	8,699	12,030
October	1,206	2,095	2,246	2,946
November	708	785	988	515
December	480	499	1,270	417
Total	12,155	17,750	21,250	25,205

THE NORTH AMERICAN APPLE SEASON, 1931-32

The final shipments of the North American apple season, 1931-32, reached the United Kingdom about the middle of June, although small quantities continued to arrive at ports on the Continent of Europe even after that date.

Aggregate shipments overseas from Canada and the United States during the season were equivalent to about 21,600,000 boxes, according to figures compiled by the International Apple Association; these figures relate to the period up to the end of April, but the figures for the complete season are not likely to be materially greater. Compared with the 1930-31 season when the record total of 23,400,000 boxes was reached, shipments show a decline of over 1,800,000 boxes, although the commercial apple crop was much larger.

The decrease in shipments during the season was entirely due to the substantially smaller exports of boxed apples, which declined from the record total of nearly 12½ million boxes in the previous season to 9,140,000 boxes. Shipments of barrelled apples increased by 420,000 to 4,140,000 barrels, and this is the largest figure since 1926-27. Particulars of total oversea shipments of apples from North America during 1931-32 and the five preceding seasons are shown in Table I.

TABLE I.—*Oversea Shipments of Apples from Ports in Canada and the United States.*

Season.	Barrels.	Boxes.	Total (as boxes).	Commercial Apple Crop (as boxes).
	Thousand.	Thousand.	Thousand.	Thousand.
1926-27	5,005	7,516	22,530	127,185
1927-28	1,962	4,929	10,814	86,484
1928-29	3,600	11,727	22,527	116,091
1929-30	2,827	5,742	14,223	98,349
1930-31	3,718	12,246	23,400	110,821
1931-32	4,140	9,142	21,562	115,115

The totals given in Table I comprise exports to all destinations, and include shipments of about 600,000 boxes to South America and the Far East in 1931-32 as compared with over one million boxes in each of the preceding three seasons. Total shipments to Europe during the season amounted to 4,130,000 barrels and 8,590,000 boxes, as compared with 3,580,000 barrels and 11,500,000 boxes in 1930-31, and 2,660,000 barrels and 5,000,000 boxes in 1929-30. Exports of barrelled apples from both Canada and the United States, particularly Canada, increased substantially, but there was a marked decline in shipments of boxed apples, which again was more pronounced as regards Canada, the total shipped from that country being under half as great as in the 1930-31 season. These figures reflect the respective crops in the barrel and box areas in Canada, and the

United States, the commercial yield in the eastern barrel areas being heavier and crops in the western box areas being, on the whole, much lighter than in the previous season. But it may be noted that whereas the decline in the combined total shipments of box apples was almost exactly proportional to the fall in the crops, the increase in the barrel crop was not reflected to the same extent in larger shipments. Table II shows shipments to Europe from Canada and the United States respectively in 1931-32 and the three previous seasons. The figures are compiled from weekly advices, and are only approximate.

TABLE II.—*Shipments of Apples from Canada and the United States to Europe.*

	1928-29.	1929-30.	1930-31.	1931-32.
<i>Canada—</i>	Thousand.	Thousand.	Thousand.	Thousand.
Barrels	679	1,427	1,085	1,408
Boxes	851	562	1,187	470
Total (as boxes)	2,888	4,843	4,441	4,694
<i>United States—</i>				
Barrels	2,797	1,235	2,491	2,724
Boxes	9,940	4,426	10,300	8,117
Total (as boxes)	18,331	8,131	17,774	16,289
Total, Canada and United States (as boxes) ..	21,219	12,974	22,215	20,983

It will be seen from Table II that shipments of Canadian apples to Europe in 1931-32 slightly exceeded shipments in the previous season, although they did not attain to the 1929-30 level. The increase was due to the appreciably larger exports of barrel apples from Nova Scotia, which rose from 989,000 to 1,193,000, and the much greater shipments from Ontario, which, at 215,000 barrels, were more than twice as great as in the previous season. These increases, were, however, offset to a considerable extent by the sharp decline in exports of box apples from British Columbia, which fell from 1,174,000 boxes, the highest level ever reached, to 450,000 boxes, the lowest figure recorded since 1927-28. The estimated

commercial crop in British Columbia in 1931, amounted to 3,421,000 boxes, a decline of about 20 per cent. on the crop of 1930, while shipments to Europe showed a decrease of over 60 per cent. Table III shows details of shipments of Canadian apples to Europe during recent seasons.

TABLE III.—*Shipments of Canadian Apples to Europe.*

Season.	Nova Scotia.		Ontario.		British Columbia.	Total.
	Thousand barrels.	Thousand boxes.	Thousand barrels.	Thousand boxes.	Thousand boxes.	Thousand boxes.
1927-28 ..	512	7	51	8	343	2,047
1928-29 ..	637	—	42	2	848	2,887
1929-30 ..	1,332	1	95	2	560	4,844
1930-31 ..	989	4	95	9	1,174	4,441
1931-32 ..	1,193	16	215	5	449	4,695

The commercial apple crop in the United States in 1931, slightly exceeded that of 1930, and was considerably in advance of 1929, although not quite attaining the high level of 1928. Apple crops on the Continent were, however, on the whole, better than in the previous year, and although in view of the small crop in the United Kingdom total shipments sent to this country were greater, aggregate exports to Europe fell by nearly 1½ million boxes. As a result the proportion of the crop exported to Europe declined from 17·7 per cent. in 1930-31 to 15·7 per cent. during the 1931-32 season.

The proportion of the Canadian crop exported to Europe was much larger, averaging over 40 per cent. in recent years, as compared with only 14 per cent. for the United States. During the 1931-32 season exports of Canadian apples to Europe increased, but the increase was not commensurate with the larger crop, with the result that the proportion exported fell from 43·4 per cent. in 1930-31 to 41·6 per cent. Nova Scotia, which in recent years has alternated with British Columbia in producing the largest part of the commercial crop in the Dominion, grows apples mainly for export; in 1931-32 Nova Scotia exported to Europe about 87 per cent. of the total commercial crop as compared with 84·5 and 76·7 per cent. respectively in the two preceding seasons. Exports from Ontario are increasing steadily and from less than 8 per cent. in 1928-29 the

proportion of the crop exported to Europe rose to over 20 per cent. The proportion of its crops exported to Europe by British Columbia is usually under 20 per cent., and although in 1930-31 it rose to 27 per cent., only 13 per cent. of the much smaller crop was shipped in 1931-32, and exports were actually smaller in volume than those from Ontario.

Figures of commercial production and exports for the various areas are given in Table IV.

TABLE IV.—*Proportions of Commercial Apple Crops shipped to Europe.*

	1929-30.			1930-31.			1931-32.		
	Com- mercial Crop.	Ship- ments to Europe.	Per cent.	Com- mercial Crop.	Ship- ments to Europe.	Per cent.	Com- mercial Crop.	Ship- ments to Europe.	Per cent.
	Thou- sand boxes.	Thou- sand boxes.		Thou- sand boxes.	Thou- sand boxes.		Thou- sand boxes.	Thou- sand boxes.	
<i>Canada—</i>									
Nova Scotia ..	5,214	3,997	76.7	3,517	2,971	84.5	4,125	3,595	87.2
Ontario ..	2,636	287	10.9	1,911	294	15.4	2,927	650	22.2
British Columbia	3,304	560	17.0	4,332	1,174	27.0	3,421	449	13.1
Total ..	11,820(a)	4,844	41.0	10,234(a)	4,441	43.4	11,296(a)	4,694	41.6
<i>U.S.A.—</i>									
Barrel area ..	46,782	3,705	7.9	48,888	7,473	15.3	64,578	8,172	12.7
Box area ..	39,747	4,426	11.1	51,699	10,300	19.9	39,198	8,117	20.7
Total ..	86,529	8,131	9.4	100,587	17,773	17.7	103,776	16,289	15.7

(a) Including Quebec and New Brunswick.

During the 1930-31 season shipments to the Continent accounted for 53 per cent. of the total shipments of North American apples to Europe, that being the first season in which larger quantities were sent to Continental destinations than to the United Kingdom. In 1931-32, however, demand from European countries was considerably restricted, owing partly to more satisfactory crops and partly to trade depression and exchange restrictions, particularly in Germany, the principal market after the United Kingdom. As a result total shipments declined from 11,813,000 boxes in 1930-31 to 7,624,000 boxes, and the proportion fell from 53 to 36 per cent. But it is indicative of the place which apples from North America have established for themselves on the Continent that, in a season so unfavourable for

external trade generally, and when European crops were on the whole fairly good, shipments to the Continent reached a level only twice previously exceeded; and that, with United Kingdom crops very light, the Continent should yet have taken so high a proportion as 36 per cent. of the shipments to Europe.

The quantity sent to the United Kingdom on the other hand, where, as previously mentioned the crop was very light, showed a sharp increase, the total of 13,359,000 boxes representing an advance of 28 per cent. on 1930-31, while the proportion shipped to this country rose from 47 to 64 per cent. This total was the largest since the 1926-27 season, although the proportion of aggregate European shipments remained well below the level of that season. Table V shows the proportion of shipments to Europe destined for the United Kingdom and the Continent respectively during recent seasons. Barrels are included in the terms of boxes in figures in the table.

TABLE V.—*Shipments of Apples from Canada and the United States to the United Kingdom and the Continent of Europe.*

Season.	To United Kingdom.		To Continent.		Total.
	Thousand boxes.	Per cent.	Thousand boxes.	Per cent.	Thousand boxes.
1926-27 ..	17,962	83	3,548	17	21,510
1927-28 ..	8,297	83	1,747	17	10,004
1928-29 ..	12,802	60	8,417	40	21,219
1929-30 ..	10,150	78	2,824	22	12,974
1930-31 ..	10,402	47	11,813	53	22,215
1931-32 ..	13,359	64	7,624	36	20,983

Exports of Canadian apples to the Continent in the 1931-32 season showed some contraction; about 10 per cent. of the shipments for Europe, comprising some 138,000 barrels and 38,000 boxes, were consigned to Continental ports as compared with 27 per cent. (380,000 barrels and 56,000 boxes) in 1930-31. Normally the United Kingdom takes well over 90 per cent. of Canada's exports to Europe.

THE SOUTH AFRICAN DECIDUOUS FRUIT SEASON, 1931-32

Shipments of deciduous fruit from South Africa to the United Kingdom in the 1931-32 season totalled about 2,311,000 packages, an increase of 482,000 packages over the previous season, and an aggregate

exceeded only once before, in the 1929-30 season. In actual volume of fruit, however, the season established a new record, the quantity shipped having amounted to approximately 40,400 shipping tons, as against 39,300 tons in 1929-30. The increasing substitution of bushel boxes for trays for the conveyance of pears now invalidates comparison of shipments in terms of packages from season to season, and this must be borne in mind in examining the figures in the table of aggregate shipments appearing below.

In the following table are shown shipments of each variety of deciduous fruits from South Africa during the past six seasons.

Shipments of Deciduous Fruits from South Africa.

Description of Fruit.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Packages.	Packages.	Packages.	Packages.	Packages.	Packages.
Peaches	326,463	178,223	316,619	421,831	329,375	491,208
Nectarines	35,708	32,584	57,765	49,090	41,193	51,332
Pears	347,916	997,339	340,293	992,235	302,545	486,289*
Plums	241,470	219,973	246,500	418,014	440,743	433,403
Fresh Prunes	22,164	7,823	20,583	19,472	13,809	44,325
Grapes	499,880	458,334	520,264	521,882	652,111	748,311
Apples	6,713	4,830	10,521	8,541	33,852	43,983
Melons	409	479	2,127	1,126	5,826	5,353
Apricots	3,755	7,915	3,953	6,318	7,765	4,124
Mangoes	381	1,093	819	879	715	595
Persimmons	193	214	447	782	325	680
Quinces	192	398	164	237	329	56
Avocado Pears	229	635	57	16	29	63
Pomegranates	99	40	70	40	100	134
Egg fruit	459	—	—	—	20	—
Litchies	374	1,283	109	50	413	812
Cherries	—	—	—	370	—	—
Grenadillas	886	1,201	901	331	380	378
Gooseberries	1,067	—	—	—	—	20
Strawberries	171	—	—	—	—	—
Figs	—	—	—	10	—	—
Not classified	25	—	6	—	—	6
Total	1,488,554	1,912,364	1,521,198	2,441,224	1,829,530	2,311,072

* Includes 203,000 bushel boxes.

Shipments in 1931-32 included record quantities of peaches and grapes, which amounted to 491,000 and 748,000 packages respectively. Shipments of pears were heavier than in the preceding season, but

were below the quantity shipped in 1929-30, while shipments of apples were heavier than in any previous season. Shipments of plums showed a slight decline as compared with 1930-31, but the combined total of plums and fresh prunes reached a new high level. There was a substantial increase in shipments of nectarines, but the aggregate did not quite equal that of 1928-29. Among the minor fruits, melons showed a slight decrease by comparison with last season, whilst a considerable decline was recorded in shipments of apricots.

In terms of packages shipments of pears are shown in the above table to have declined considerably in 1931-32 by comparison with 1927-28 and 1929-30, the two seasons of heavy shipments, but according to a record of the number of bushel boxes of pears comprised in each shipment, the total of 486,000 packages included no less than 203,000 boxes, making the aggregate volume of pears shipped only slightly less than in the two earlier seasons. This approximation is confirmed by the imports of pears from South Africa recorded by the Customs Department in the United Kingdom. Imports exceeded 91,000 cwts., which is not far short of the recorded imports in the 1927-28 and 1929-30 seasons (101,000 and 108,000 cwts. respectively).

The larger supplies of pears met with less competition from other sources during the season by comparison with the preceding year in spite of an increase in arrivals from Argentina, as shipments from the United States during the period when South African pears were on the market amounted to only 60,000 boxes as against 280,000 boxes in 1931. Arrivals from Argentina increased from 4,000 boxes to 54,000 boxes. Supplies of Argentine grapes were, however, lighter than a year earlier, arrivals having totalled approximately 100,000 boxes as compared with 150,000 boxes in 1931.

THE AUSTRALIAN AND NEW ZEALAND DECIDUOUS FRUIT SEASON, 1932

A new record was established in shipments of apples from Australia and New Zealand in the 1932 season, when a total of nearly 5,900,000 boxes reached Europe from these two countries, as compared with 4,300,000 boxes in the preceding year and 5,400,000 boxes in 1930, the previous highest total recorded. A new high level was also reached in the quantity of pears shipped from New Zealand but shipments of Australian pears were lighter than in either of the two preceding years.

A pre-season estimate of shipments to Europe, which appeared in the "Weekly Fruit Intelligence Notes" in February, 1932, gave provisional totals of about 4,000,000 boxes of apples from Australia (including 3,000,000 boxes from Tasmania) and from 1,250,000 to 1,400,000 boxes of apples from New Zealand. Later reports gave no indication of any material change in the situation, except that shipments from Western Australia were expected to exceed earlier forecasts. Shipments of pears were estimated at 260,000 boxes from Australia and 60,000 boxes from New Zealand.

The actual totals shipped were higher than these estimates, and included about 4,452,000 boxes of apples from Australia and 1,446,000 boxes from New Zealand. The Australian figure shows an increase of 1,307,000 boxes over the 1931 season, and is 134,000 boxes more than the previous record in the 1930 season. New Zealand shipments increased for the third year in succession, and the season's total was about 311,000 boxes higher than 1931. Shipments of pears from Australia amounted to the equivalent of 273,000 bushel boxes, or 72,000 boxes less than in the preceding season, while New Zealand's record total comprised about 93,000 boxes, as compared with an average of 55,000 boxes in recent years.

The decline shown in the previous season in the proportion of Australian apple shipments going to Continental ports, continued in 1932, and about 444,000 boxes, or only 10 per cent. of the total, were shipped to the Continent. New Zealand's shipments of apples to the Continent increased considerably in 1931, but in 1932 they declined again to just below the 1930 level; the season's total of 154,000 boxes represents about 11 per cent of the aggregate quantity shipped from New Zealand to Europe. The United Kingdom's share thus amounted to 5,300,000 boxes, comprising 4,008,000 boxes from Australia and 1,292,000 boxes from New Zealand, or 90 per cent. of the total shipments to Europe, as compared with an average of 75 per cent. in the preceding two seasons. Competition in the United Kingdom market for Australian and New Zealand apples comes mainly from the United States, from which source supplies usually continue to reach this country well into the middle of the summer. In 1932 arrivals of American apples were considerably heavier in March than in the same month of 1931, but from April to July inclusive the total was equivalent to only 470,000 boxes, as compared with 760,000 boxes during the corresponding period last year.

Shipments of Australian pears to the United Kingdom were equivalent to about 267,000 boxes, but shipments to Continental ports were almost negligible. On the other hand, an increase is shown in the quantity of pears, about 17,000 boxes, shipped from New Zealand to the Continent, the total for the United Kingdom amounting to 76,000 boxes.

In Table I are shown shipments of apples and pears to Europe from each State in Australia and from New Zealand. The figures given include all packages converted to an equivalent number of bushel boxes.

TABLE I.—Aggregate Shipments of Australian and New Zealand Apples and Pears to Europe.

Whence Consigned.	Apples.			Pears.		
	1930.	1931.	1932.	1930.	1931.	1932.
	Thou- sand boxes.	Thou- sand boxes.	Thou- sand boxes.	Thou- sand boxes.	Thou- sand boxes.	Thou- sand boxes.
<i>To United Kingdom—</i>						
Victoria.. ..	638	250	129	139	200	128
New South Wales ..	49	36	—	6	4	—
South Australia ..	284	17	323	11	3	8
Western Australia ..	48	231	488	7	20	45
Tasmania	2,176	1,893	3,067	91	94	86
Queensland	—	—	1	—	—	—
Total Australia to U.K.	3,195	2,427	4,008	254	321	267
Total New Zealand to U.K.	938	755	1,292	43	45	76
<i>To Continent—</i>						
Victoria.. ..	235	95	—	—	12	—
New South Wales ..	—	—	—	—	—	—
South Australia ..	123	—	93	6	—	—
Western Australia ..	277	213	200	8	—	4
Tasmania	488	410	151	7	12	2
Total Australia to Con- tinent.	1,123	718	444	21	24	6
Total New Zealand to Continent.	167	380	154	13	10	17
<i>To U.K. and Continent—</i>						
From Australia ..	4,318	3,145	4,452	275	345	273
From New Zealand ..	1,105	1,135	1,446	56	55	93

Shipments of grapes from Australia to the United Kingdom in 1932 were equivalent to about 24,500 boxes, showing a substantial increase over the previous season's total of 13,800 boxes, but shipments of plums were negligible.

As in past years, the bulk of the apple shipments to the United Kingdom from both Australia and New Zealand came to London, the proportion of the total being nearly two-thirds in each case. This is about the same as in the preceding season as regards Australia, but shows a considerable increase in New Zealand shipments, of which about one-half came to London in 1931. Southampton's share of New Zealand apple shipments increased in 1931 to 31 per cent. of the total, but declined again in the 1932 season to 18 per cent. No very marked changes are apparent in the proportions taken by other ports by comparison with the previous year.

Table II shows the quantities of Australian and New Zealand apples arriving at the different ports in the United Kingdom in 1932 and in the preceding two seasons.

TABLE II.—*Ports of Arrival of Australian and New Zealand Apples, 1930-32.*

Port.	1930.		1931.		1932.	
	Thousand boxes.	Per cent. of total.	Thousand boxes.	Per cent. of total.	Thousand boxes.	Per cent. of total.
<i>From Australia.</i>						
London	1,864	58	1,641	68	2,651	66
Southampton	115	4	2	—	1	—
Liverpool	607	19	500	21	734	18
Glasgow	126	4	74	3	178	5
Manchester	95	3	26	1	35	1
Hull	388	12	184	7	409	10
Total	3,195	100	2,427	100	4,008	100
<i>From New Zealand.</i>						
London	516	55	376	50	816	63
Southampton	130	14	233	31	236	18
Liverpool	39	4	33	4	89	7
Glasgow	97	10	65	9	76	6
Manchester	84	9	32	4	51	4
Hull	37	4	—	—	—	—
Avonmouth	35	4	16	2	24	2
Total	938	100	755	100	1,292	100

During the early part of the season arrivals were not much different from those in the seasons of 1930 and 1931. Up to 24th May total arrivals of Australian and New Zealand apples at United Kingdom ports amounted to 1,578,000 boxes, as compared with 1,297,000 boxes in the corresponding period of 1931 and 1,539,000 boxes in the same period of 1930. Up to the end of May prices at the London sales averaged rather over 10s. per box, which was lower than in either 1930 or 1931, but only by 12 and 7 per cent. respectively—not a great difference in view of the economic situation. But beginning with the last week in May, arrivals became very heavy, and during the six weeks ended 5th July, the weekly average amounted to 545,000 boxes, as compared with 250,000 in the same six weeks in 1931 and 310,000 in 1930. During June prices fell steadily, until at the end of the month Tasmanian apples were realizing barely 5s. per box. On the average over the whole month, June prices of Australian apples were fully 25 per cent. below those of 1930 and 1931. During July arrivals declined rapidly, and prices recovered, Tasmanian Sturmers realizing their highest prices of the season during the closing days of the month.

The earlier period of comparatively good prices did not, of course, compensate for the very low prices ruling during June and the early part of July, during which period the greater part of the season's supplies came on the market. Over the whole season a weighted average would probably show a fall in wholesale prices of little less than 20 per cent. as compared with 1931.

THE SUMMER ORANGE SEASON, 1932

Aggregate supplies of oranges arriving in the United Kingdom in the 1932 summer orange season showed some decrease by comparison with 1931, but were still very much heavier than in any previous season. Shipments from South and East Africa, the United States and Brazil totalled about 3,800,000 boxes as against 4,600,000 boxes in 1931 and 2,500,000 boxes in 1930.

The estimates given in the survey of prospects for the season published in the "Weekly Fruit Intelligence Notes" in April, 1932, proved to be approximately correct. Shipments of oranges from the Union of South Africa fell just short of the estimate of 1,700,000 boxes, the actual total being 1,673,000 boxes, or 201,000 boxes more than in the previous year, and only 23,000 boxes less than the record quantity shipped to the United Kingdom in 1930. Southern

Rhodesian shipments to this country (via Beira, Durban and Cape Town) amounted to 153,000 boxes, an increase of 9,000 boxes over the preceding season. From Brazil shipments totalled about 1,500,000 boxes, and thus failed to equal the record of over 1,700,000 boxes established in 1931, while only about 400,000 boxes of Californian oranges were shipped to this country, as compared with over 1,100,000 boxes in the previous season. Of the remaining countries normally marketing oranges in the United Kingdom in the summer months, Portuguese East Africa shipped an increased total of 34,000 boxes (including exports from Lourenço Marques and Beira), but only negligible quantities arrived from Australia and Argentina. The Spanish orange season usually extends into the summer months, and in 1932 the final shipments did not arrive until August, considerably later than in 1931. In spite of this, however, the actual total shipped from April onwards was smaller than in the previous year, and competition from this source was accordingly slightly less.

In Table I are shown aggregate arrivals of oranges in the United Kingdom from the principal sources of supply during the summer months of 1932, with comparative figures for the two preceding years. Arrivals from Spain are not included.

TABLE I.—Arrivals of "Summer" Oranges at United Kingdom Ports.

Country of Origin.	1930.	1931.	1932.
	Thousand Boxes	Thousand Boxes	Thousand Boxes
Union of South Africa—Oranges ..	1,696	1,472	1,673
Naartjes ..	21	17	19
Southern Rhodesia (a)	157	144	153
Portuguese East Africa	26	26	34
Brazil—Oranges	527	1,725	1,487
Tangerines	3	57	20
Argentina	1	33	(c)
United States (California)	34	1,129(b)	415
Australia	(c)	12	(c)
Total	2,465	4,615	3,801

(a) Including shipments through Beira, Durban and Cape Town.

(b) Arrivals after 28th February.

(c) Less than 500 boxes.

It was reported at the beginning of the South African season that the crop of Navel oranges in that country was expected to be short, but that a good crop of Valencias was anticipated. Reports from Brazil indicated that the crop in Sao Paulo, which is usually marketed before August, would be smaller than in 1931, while in the State of Rio de Janeiro, from which oranges are normally shipped from July onwards, a production almost as heavy as in 1931 was anticipated. On this basis it was safe to assume that supplies of oranges from these two countries combined were likely to be comparatively short during the early summer, while later in the season supplies would tend to be heavier. This proved to be the case; aggregate arrivals from South Africa up to the end of July were about 100,000 boxes less than in 1931, while shipments to the United Kingdom from Santos, Sao Paulo, amounted to approximately 600,000 boxes, as against over 700,000 boxes in the preceding year. Of the total from Sao Paulo about one-half had already arrived, when the first shipment from South Africa reached this country at the end of May. Shipments arriving from South Africa from August onwards were on a considerably higher scale than a year previously, and continued for a fortnight later than in 1931, the last shipment not arriving until 19th December. On the other hand, shipments from Rio de Janeiro did not total much more than 900,000 boxes, or some 100,000 boxes less than in the preceding year. But the Brazilian season finished in the third week of November, whereas in 1931 it lasted almost until Christmas, so that actual arrivals from Brazil each week from August onwards were on the average heavier than twelve months earlier, and thus offered greater competition to the larger supplies of South African oranges available during the period.

Supplies of Californian oranges reached the United Kingdom very early in 1931, but in 1932 regular shipments did not begin to arrive before the end of May; by comparison with the quantities coming from the Southern Hemisphere arrivals remained on a small scale throughout the summer, but the peak, reached in July, coincided with a period when supplies from Brazil had fallen off temporarily. As already stated, arrivals of oranges from Spain during the early summer months were on a lower level than in the preceding year.

Aggregate arrivals of oranges from all sources from April to the middle of August were considerably lighter than in 1931, but from then until the end of October supplies were heavier. During November

arrivals were exceptionally light on account of the late start of the new Spanish season, arrivals from Spain being very much below the quantity coming forward in November, 1931.

Table II shows imports of oranges into the United Kingdom recorded in the eight months April to November in 1932, and the two preceding years. The figures are based on special returns obtained from the Customs and Excise Department, but some adjustments in the imports recorded in the different months of 1932 have been necessary to counteract the increased time lag in passing Customs entries, which followed the introduction of import duties at the beginning of March.

TABLE II.—Imports of Oranges into the United Kingdom.

Country whence consigned.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total (eight months).
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
1930.									
Spain	1,023	966	593	168	2	1	1	196	2,950
Palestine ..	222	1	—	—	—	—	—	13	236
South Africa } S. Rhodesia }	—	1	46	267	220	208	289	69	1,100
United States	1	9	16	1	—	—	—	—	27
Brazil	—	12	42	43	41	79	96	32	345
Other countries	16	21	6	9	11	17	—	2	82
Total ..	1,262	1,010	703	488	274	305	386	312	4,740
1931.									
Spain	807	605	215	—	—	—	4	273	1,904
Palestine ..	111	—	—	—	—	—	1	52	164
South Africa } S. Rhodesia }	—	2	74	271	148	148	275	52	970
United States	40	94	154	169	168	88	67	1	781
Brazil	11	93	169	188	135	98	178	163	1,035
Other countries	15	7	11	32	24	47	19	16	171
Total ..	984	801	623	660	475	381	544	557	5,025
1932.									
Spain	616	520	95	26	2	—	7	107	1,373
Palestine ..	235	1	—	—	—	—	—	21	257
South Africa } S. Rhodesia }	—	3	84	188	193	209	323	74	1,074
Brazil	5	127	165	105	142	183	183	61	971
United States	—	24	31	89	57	52	32	7	292
Other countries	5	4	2	4	14	12	9	5	55
Total ..	861	679	377	412	408	456	554	275	4,022

The effect of the difference in total supplies of oranges available in the early summer months of 1932, as compared with later months, is clearly reflected in the prices realised for South African oranges. The short supplies available from all sources in June, July and August led to a substantial increase in the prices realised for South African Navel and Seedling oranges as compared with the previous year, and during these months prices were higher than in any season since that of 1928. In September and October the heavier supplies resulted in a marked decline, prices of South African Valencias falling to levels even lower than those of the corresponding months in 1931, and although a recovery occurred in November, average returns still remained below those of twelve months earlier. It is not easy to estimate how far the gains realised by comparison with the previous year on the shorter supplies of Navels and Seedlings in the early part of the season counterbalanced the losses on the larger supplies of Valencias in the later months, but over the whole season it seems likely that there was an average increase of about 2s. a box over 1931 prices.

THE JAFFA ORANGE SEASON, 1931-32

A report at the beginning of the 1931-32 season forecast the Jaffa orange crop at from $3\frac{1}{4}$ to $3\frac{1}{2}$ million boxes. This estimate was more than realised; shipments to all destinations reached the unprecedented total of 3,632,000 boxes, as compared with 2,470,000 boxes in the previous season, and exceeded by nearly one million boxes the previous record total of 2,696,000 boxes in 1929-30. The season started eight days later than in the previous year in accordance with the instructions of the Government Fruit Inspection Service.

Exports both to the United Kingdom and to the Continent recorded new high levels. Shipments to this country for the first time reached $2\frac{1}{2}$ million boxes, and the Continent took just over one million boxes. A little over 70 per cent. of the total exports were shipped to the United Kingdom, a slight increase on the previous season's percentage of 69. The Continent took the same proportion as in the previous season, about 29 per cent. of the total.

Shipments to Continental countries have quadrupled in the past five seasons. Increased exports to Germany, Roumania and Scandinavian countries has been mainly responsible for this rapid development. Increases were shown by nearly every country in comparison with the previous year, with the result that the percentage

of total exports taken by Germany declined from 21 to 18 per cent., although shipments to that country increased by nearly 150,000 boxes.

Shipments from the port of Haifa showed a further substantial advance to 800,000 boxes, as compared with 500,000 boxes in the previous season.

Table I shows exports of oranges from Palestine in the past five seasons.

TABLE I.—*Exports of Oranges from Palestine.*

	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Boxes.	Boxes.	Boxes.	Boxes.	Boxes.
Liverpool	614,500	424,000	585,500	585,000	786,000
Glasgow	393,000	261,000	384,500	354,500	525,000
Manchester	292,000	204,000	344,000	234,000	374,000
Hull	236,000	168,500	342,000	221,000	345,000
London	142,000	142,000	254,500	242,000	373,000
Southampton	27,500	19,500	28,000	26,000	58,000
Cardiff	24,000	29,000	53,000	47,000	82,000
Bristol	—	5,000	—	—	—
Newcastle	—	6,000	—	7,000	15,000
Belfast	—	—	6,000	8,500	5,000
Total to United Kingdom	1,729,000	1,259,000	1,997,500	1,725,000	2,563,000
Germany	141,500	191,000	421,000	510,500	655,000
Roumania	52,000	37,000	39,000	43,000	102,000
Netherlands	32,500	34,000	35,500	12,000	50,000
France	9,000	17,500	11,500	7,000	21,000
Bulgaria	2,500	8,500	5,000	7,000	8,000
Denmark					72,000
Sweden			42,500	84,000	39,000
Norway					24,000
Poland			2,000	6,000	16,000
Czechoslovakia	24,500	29,000	2,000	5,000	9,000
Latvia			—	3,500	10,500
Yugoslavia			—	4,000	7,000
Austria			3,500	9,000	7,000
Other European countries			7,000	12,000	16,500
Total to Continent ..	262,000	317,000	569,000	703,000	1,037,000
Other destinations ..	5,000	4,500	129,500	42,000	32,000
Total	1,996,000	1,580,500	2,696,000	2,470,000	3,632,000

Shipments to other destinations included 13,500 boxes to India and 6,000 boxes to Canada, as compared with 6,000 boxes and 700 boxes respectively in the 1930-31 season, but shipments to Egypt showed a further substantial decline to 5,000 boxes in comparison with 25,000 boxes in the previous season.

Exports of grapefruit from Palestine in the 1931-32 season amounted to 106,000 boxes, of which the United Kingdom took 69,000 boxes. This compares with a total export of 40,000 boxes in the previous season.

A comparison between Palestine and Spanish orange exports may be made by reference to the review of the 1931-32 Spanish orange season which appears in the following pages. As will be seen from Table II, a far larger proportion of the Palestine than the Spanish crop is shipped to the United Kingdom, and the proportion from Spain tends to decline.

TABLE II.—*Distribution of Palestine and Spanish Orange Exports.*

Distribution.	Palestine.		Spain.	
	Million boxes.	Percentage of total.	Million boxes (a).	Percentage of total.
<i>Season 1929-30—</i>				
To United Kingdom ..	2·0	74	11·6	33
To other destinations ..	0·7	26	23·2	67
Total	2·7	100	34·8	100
<i>Season 1930-31—</i>				
To United Kingdom ..	1·7	69	8·1	31
To other destinations ..	0·8	31	18·0	69
Total	2·5	100	26·1	100
<i>Season 1931-32—</i>				
To United Kingdom ..	2·6	70	8·4	29
To other destinations ..	1·0	30	20·6	71
Total	3·6	100	29·0	100

(a) For purposes of comparison Spanish half-cases have been converted to the equivalent of standard boxes.

The Spanish commercial crop has averaged over the past five seasons about 20 million half-cases, which is equivalent to about 28 million standard boxes, and in 1929-30 a record crop equivalent to some 35 million standard boxes was obtained. In face of these figures the Palestine output is still comparatively low. But whereas there appears to be no evidence at present of any considerable expansion in Spanish production in the near future, there is every indication that the substantial increase last season in the Palestine output is only the beginning of a progressive upward movement.

THE SPANISH ORANGE SEASON, 1931-32

Shipments of oranges from Spain in the 1931-32 season started somewhat later than in recent years owing to the lateness of the crop, but the season lasted longer than usual. While shipments to the Continent were finished by the end of May, exports to the United Kingdom continued on a small scale up to the first week in August.

In spite of lack of rain in the early stages of growth, a satisfactory crop was secured. Total shipments by sea from the Levante district of Spain during the season amounted to 12,650,000 half-cases, which was about 1,000,000 half-cases more than in the previous season, but about 3,700,000 half-cases less than the record total shipped in 1929-30. Shipments to the Continent by sea, which for some years have been only slightly lower than shipments to this country, were, for the first time, in excess of those to the United Kingdom to the extent of some 400,000 half-cases.

Table I gives comparative figures of shipments of cases and half-cases of oranges (including mandarines) in terms of half-cases to the principal United Kingdom and Continental ports in the past five seasons, according to statistics supplied by the Empire Marketing Board's correspondents at Valencia.

Shipments to London and Liverpool together continue to account for more than 60 per cent. of the total exports to the United Kingdom. Shipments to Antwerp and various other Continental ports are developing at a greater rate than exports by sea to Germany and Holland.

Exports over the frontier of Spain continue to increase, and are now only slightly less important than shipments by sea to the Continent. Table II shows quantities exported overland via Cerbera and Hendaye in the past three seasons. The figures for the 1931-32 season include small quantities exported for the first time via Canfranc.

TABLE I.—*Shipments of Oranges from Burriana, Castellon, Valencia, Gandia, Denia and Cartagena.*

Destination.	Season 1927-28.	Season 1928-29.	Season 1929-30.	Season 1930-31.	Season 1931-32.
	Thousand Half- cases.	Thousand Half- cases.	Thousand Half- cases.	Thousand Half- cases.	Thousand Half- cases.
London.. .. .	2,530	2,305	3,196	2,222	2,422
Liverpool	1,631	1,498	2,270	1,570	1,422
Hull	569	424	529	378	367
Manchester	600	403	471	242	197
Newcastle	227	191	350	234	255
Glasgow	430	372	453	352	309
Bristol	365	291	397	304	309
Cardiff	212	157	296	216	224
Other United Kingdom Ports	332	296	452	363	630
Total to United Kingdom ..	6,896	5,937	8,414	5,881	6,135
Hamburg and Bremen ..	3,248	2,645	3,886	2,588	2,594
Rotterdam and Amsterdam ..	1,454	1,426	2,214	1,573	1,659
Antwerp	915	710	715	779	1,068
Other Continental Ports ..	756	750	1,117	791	1,199
Total to Continent	6,373	5,531	7,932	5,731	6,520
Total	13,269	11,468	16,346	11,612	12,655

TABLE II.—*Exports of Oranges Overland from the Valencia District.*

Season.	Trucks.	Tons.	Equivalent in half-cases.
1929-30	53,200	298,000	5,960,000
1930-31	49,300	276,000	5,520,000
1931-32	56,900	322,000	6,440,000

Consignments to home markets and to local ports for home consumption totalled about 106,000 tons, or the equivalent of some 2,120,000 half-cases, as compared with about 97,000 tons or 1,940,000 half-cases in the previous season.

The above figures give a total commercial crop in the Levante district of Spain in the 1931-32 season of about 21 million half-cases of roughly one cwt. each, as compared with a commercial crop of about 19 million half-cases in the previous season. The approximate distribution of the commercial crop in the past three seasons is shown in Table III. The figures exclude Seville oranges and fruit produced in minor areas of Spain.

TABLE III.—*Distribution of Spanish Commercial Orange Crop.*

Distribution.	Season 1929-30.		Season 1930-31.		Season 1931-32.	
	Million half-cases.	Per-centage of total.	Million half-cases.	Per-centage of total.	Million half-cases.	Per-centage of total.
To United Kingdom ..	8.4	33.2	5.9	31.0	6.1	28.9
To Continent (by sea) ..	7.9	31.3	5.7	30.0	6.5	30.8
By rail across French border	5.9	23.3	5.5	29.0	6.4	30.3
Interior distribution ..	3.1	12.2	1.9	10.1	2.1	10.0
Total	25.3	100.0	19.0	100.0	21.1	100.0

IMPORTS OF FRUIT INTO GERMANY

In pre-war years total imports of raw fruit into the United Kingdom and Germany stood at about the same level, but although imports into Germany in recent years are much higher than in the pre-war period, the increase in the United Kingdom's imports has been far heavier, so that there is now a much wider disparity between the fruit import trade of the two countries.

In Table I are shown, in round figures, average imports of the six principal raw fruits into the United Kingdom and Germany in the three years immediately preceding the war and in the three years, 1930-32. These figures show that Germany imported only 10 per cent. less fruit than the United Kingdom in the pre-war years, whereas the post-war figures show a difference of nearly 40 per cent. Both countries have experienced changes of boundaries since the war, but these account for only a small part of the difference.

Imports of apples show the most striking change in the two periods. Whereas imports into the United Kingdom have more than doubled, Germany's imports have declined by about 35 per cent. Both

countries produce a fair proportion of their own apple requirements and the variation in imports may to some extent be attributable to changes in home production. But, although Germany's imports of apples in 1932 were the highest recorded in post-war years, they amounted to little more than 80 per cent. of the pre-war average.

TABLE I.—Average Imports of Raw Fruit into the United Kingdom and Germany.
(Thousands of tons.)

Description.	United Kingdom.		Germany.	
	1911-13.	1930-32.	1911-13.	1930-32.
Apples	174	367	309	203
Pears	32	56	44	35
Grapes	32	42	36	64
Oranges	277	499	137	284
Lemons	37	72	37	71
Bananas	107	244	36	111
Total	659	1,280	599	768

With the one exception of imports of pears into Germany, increases are recorded by both countries in all the other fruits included in the table. Imports of pears into the United Kingdom increased by nearly 80 per cent., as against a decline of 35 per cent. shown by Germany, but in imports of oranges the United Kingdom shows an increase of barely 80 per cent., and Germany over 100 per cent. Germany's imports of bananas are more than three times as heavy and imports into the United Kingdom nearly two and a half times as heavy as in pre-war years, but consumption of bananas in Germany, in spite of the rapid advance in recent years, still shows the greatest disparity of any fruit as between the two countries. Imports of lemons have increased to about the same extent in both countries, but Germany's imports of grapes show a considerably larger increase than those of the United Kingdom. Grapes afford the only instance in the above list in which imports into Germany exceeded those into the United Kingdom both in pre-war and in post-war years.

Table II shows imports of the same fruits into Germany in the past six years. In spite of variations from year to year in individual fruits there was a steady development generally up to 1930 inclusive, which was checked in the following year by the substantial declines in imports of apples and oranges as compared with the previous year. A large increase in imports of apples caused a recovery in aggregate imports in 1932, as compared with 1931, but the total was still considerably below that of 1930.

TABLE II.—*Imports of Raw Fruit into Germany.*
(Thousands of tons.)

Description.	1927.	1928.	1929.	1930.	1931.	1932.
Apples	169	209	160	240	116	252
Pears	60	55	60	35	45	27
Grapes	47	62	75	70	68	55
Oranges	206	255	234	345	274	233
Lemons	57	55	61	71	74	69
Bananas	65	86	101	116	108	111
Total	604	722	691	877	685	747

British Empire countries continue to figure only to a limited extent among the countries contributing to Germany's raw fruit supplies, except in regard to bananas, of which nearly 70 per cent. were recorded as being imported in 1932 from the British West Indies. Australia's share of the apple imports in the same year amounted to less than 3,000 tons, as compared with 5,000 tons in 1931, and New Zealand's contribution declined from over 4,000 tons in 1931 to little more than 3,000 tons in 1932. Imports of apples from the United States continue to be heavier than from any other country, but the total of 60,000 tons imported in 1932 showed a decline in comparison with 1931, and was very closely followed by the heavy imports from Austria which amounted to 55,000 tons. The incidence of a light crop in Germany and heavy crops in Austria and Italy resulted in the movement of very large supplies into Germany from those countries, as well as from Yugoslavia. These three countries together accounted for no less than 130,000 tons, or more than 50 per cent. of the total apple imports, which as stated above, were the heaviest recorded in post war years. A large proportion of the imports from Austria and Italy consisted of cider fruit to supplement the light Wurtemberg crop.

Spain continues to supply by far the largest proportion, about 90 per cent. of Germany's orange imports, but imports from Palestine showed a further expansion in 1932 to 19,000 tons as compared with 14,000 tons in the previous year, and were actually larger than imports from Italy, which showed a heavy decline on account of the poor crop. South Africa's contribution of 1,800 tons showed no change as compared with 1931. Italy replaced Czechoslovakia last year as Germany's principal source of imports of pears, in consequence of the short crop in Czechoslovakia. Italy also supplied by far the largest proportion of the grape imports and continues to furnish the bulk of the imports of lemons. The importance of Italy in Germany's fruit import trade is further indicated in the figures of imports of other fruits. Italy supplied the bulk of Germany's imports of peaches and cherries, the largest proportion of the imports of apricots, and a very substantial proportion of the imports of plums in 1932.

Germany's substantial imports of fruit are mainly of importance to Empire producers in that they offer an alternative outlet for supplies from competitive producing countries, which might otherwise go to swell the supplies competing with Empire fruits on the British market.

IMPORTS OF FRUIT INTO FRANCE

Although France has been for many years a large importer of citrus fruits and bananas, it is only in more recent years that imports of deciduous fruits, chiefly apples, pears, grapes and peaches have shown any considerable development. As a result of the recent rapid expansion in imports of all fruits, France now follows but a little way behind Germany as a fruit importing country. Aggregate imports of the chief fruits reaching France from other countries rose to a new high level in 1932, as shown in the table below, and were nearly twice as heavy as total imports of those fruits in 1928. Imports of oranges have nearly doubled in the space of the past four years, but imports of bananas, which increased from 79,000 tons in 1927 to 221,000 tons in 1932, are the most striking example of the recent expansion. Some of the other fruits show even more rapid increases over the last three or four years, but imports of these fruits are still of minor importance as compared with oranges and bananas, which account for nearly 70 per cent. of France's total imports of fruit.

Table I shows in round figures imports of the principal fruits imported into France during the past six years.

TABLE I.—*Imports of Raw Fruit into France.*
(Thousands of tons.)

Description.	1927.	1928.	1929.	1930.	1931.	1932.
Oranges	131	157	103	162	166	198
Mandarines			26	42	43	39
Lemons			19	21	23	24
Bananas	79	109	126	181	211	221
Apples	12	22	33	41	71	61
Pears			4	9	22	17
Grapes	5	10	9	17	18	20
Peaches and Apricots ..	4	7	5	17	27	25
Total	231	305	325	490	581	605

Spain supplies about 95 per cent. of the total imports of oranges, and Spain and Algeria together account for the bulk of the imports of mandarines. Italy and Spain together supply practically all the lemons imported in the proportion of 70 per cent. and 27 per cent. respectively of the total. Nearly 60 per cent. of the total imports of bananas consist of Canary Islands produce and the bulk of the remaining supplies are imported from Central America, French West Africa and other French possessions.

Apples are the only other fruit, for which detailed information in regard to imports is available for more recent years, and the figures are reproduced in Table II. The recent expansion in imports of this fruit is mainly due to larger supplies from the United States which increased from 6,000 tons in 1929 to 34,000 tons in 1931. There was a slight drop in imports in 1932 to 33,000 tons. Imports from Italy show an increasing, and those from Belgium a decreasing tendency, and the sharp increase in imports of Canadian apples in 1930, as compared with the previous year, has since been fairly well maintained. Exports of apples from Chile to France in 1932, according to the Chilean trade returns, amounted to 1,330 tons, as compared with only 223 tons in 1931. This might account, to a large extent, for the increased imports into France from "other countries" in 1932.

TABLE II.—Imports of Apples into France.

Country whence consigned.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.
United States	6,045	11,265	34,050	33,000
Belgium	15,465	12,330	12,930	8,760
Switzerland	3,885	1,410	8,160	4,380
Netherlands	2,185	1,125	5,305	2,375
Italy	1,930	5,585	3,445	4,300
Canada	955	2,120	1,970	1,840
United Kingdom	1,015	3,195	1,825	735
Other countries	1,135	3,730	3,540	5,225
Total	32,615	40,760	71,225	60,615

Pears are imported mainly from Belgium, table grapes from Spain and Algeria, peaches from Italy and apricots from Spain.

Imports of raw fruit into France from British Empire sources are at present comparatively negligible, but the increasing trade in imports of raw fruit into France, as well as into Germany, Scandinavia and other European countries not only offers to British Empire growers alternative markets for their produce, but also relieves the British market of quantities of fruit which would otherwise compete with Empire supplies.

IMPORTS OF FRUIT INTO SWEDEN

The Scandinavian countries rank after the United Kingdom, Germany and France among the largest importers of raw fruit. They are far behind those countries in this respect, but the growth of their fruit import trade has been very rapid, and they are steadily developing as an outlet for the surplus fruit production of more southerly countries. Sweden is the most important Scandinavian fruit-importing country.

Imports of fruit into Sweden showed a very marked and consistent expansion up to and including the year 1931, but there was a set-back in 1932 to below the 1930 total, owing mainly to declines in imports of pears, oranges and bananas, as compared with the previous year. Home production barely suffices to supply one-half of the country's needs, and demand, which is being continually stimulated by

propaganda, turns more and more to imported supplies. At the same time an impetus has been given to the importing trade by improvements in warehouse and cold storage accommodation at the ports and improved transport facilities.

The following table shows imports of the six principal raw fruits into Sweden in the six years, 1927 to 1932.

Imports of Fruit into Sweden.

Description.	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
Apples	16,200	18,690	21,400	14,640	17,770	17,110
Pears	5,800	6,950	7,940	5,020	12,230	5,120
Grapes	1,140	1,390	1,670	1,820	2,130	1,930
Oranges	12,300	13,870	15,400	26,020	27,750	25,950
Lemons	1,580	1,520	1,620	2,150	2,330	2,020
Bananas	9,500	10,500	12,950	13,890	12,680	10,030
Total.. ..	46,520	52,920	60,980	63,540	74,890	62,160

The United States continues to supply the largest proportion of the apples, but imports from Australia and Germany are important. The total of 17,770 tons imported in 1931, the latest year for which details of imports are available, included 10,200 tons from the United States, 2,230 tons from Australia and 1,980 tons from Germany, while considerable quantities came from the United Kingdom and Denmark. Imports from the last three countries probably consist of fruit previously imported from other sources. Imports from Australia in 1930 amounted to 2,500 tons. Other British Empire Countries show some development but do not yet figure prominently in the returns. Imports from South Africa, Canada and New Zealand in 1931 amounted to 340 tons, 160 tons and 30 tons respectively, as compared with 16 tons, 250 tons and nil respectively in 1930. Pears are imported mainly from Czechoslovakia, lemons from Italy and grapes from Spain, while the latter country has now replaced Italy as the chief source of supply of oranges. The bulk of the imports of bananas consists of re-exported fruit shipped from the United Kingdom. A fair proportion of imports of fruit, other than apples, such as grapes, oranges and lemons, imported from Germany, also consists of re-exported produce.

The Swedish fruit crop was reported to be light last year and the decline in imports was evidently due to causes other than the quantity of home supplies available.

IMPORTS OF FRUIT INTO NORWAY

Imports of fruit into Norway showed a steady advance up to 1930, in which year total imports reached a record high level, but declined to a slight extent in the last two years. Citrus fruits have shown the greatest development, and last year's imports reached a new high level. Imports of bananas showed a consistent increase each year up to 1931, but there was a set back last year to below the 1929 figure. Imports of grapes show a gradually increasing tendency, but imports of apples and pears show no tendency at present to expand, and last year's imports were the lowest for many years.

The following table shows imports of the principal fruits into Norway during the past six years.

Imports of Fruit into Norway.

Description.	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
Apples and Pears ..	5,345	3,965	4,690	3,630	4,505	3,370
Oranges and Lemons ..	13,480	14,825	15,095	19,115	17,505	19,450
Bananas	6,585	6,945	7,870	8,290	8,575	7,710
Grapes	1,450	1,390	1,660	1,680	1,550	1,835
Total	26,860	27,125	29,315	32,715	32,135	32,365

In the Norwegian trade returns apples and pears, and oranges and lemons are not separately distinguished. The United States supplies the largest proportion of the apples and pears, imports from that country in 1931, the latest year for which details are available, amounting to 2,900 tons, mainly apples, out of a total of 4,505 tons. Fair quantities, consisting mainly of re-exported produce, were imported from Germany, the United Kingdom, Denmark and Sweden, while direct imports from the Empire were confined to the comparatively small items of 101 tons from Australia and 25 tons from Canada. Spain supplies the bulk of the citrus fruit imports and accounted for 13,000 tons, mainly oranges, of the 17,500 tons

imported in 1931. Imports from Italy, mainly lemons, amounted to 980 tons, while fair quantities, consisting of re-exported produce came from Germany and the United Kingdom. The bananas imported are chiefly of Jamaican origin, and the trade is reported to be the monopoly of an Oslo Company, which is carrying out an extensive advertising campaign for the increased consumption of this fruit. Spain furnishes the bulk of the imports of grapes.

The Norwegian crops of apples and pears in 1932 were somewhat below average. The bulk of the apple crop, mainly *Gravensteins*, is marketed during August and September. Good crops of berry fruits are grown, which suffice not only for home requirements, but leave a margin for export, and fair quantities of currants and other berry fruits are exported to the United Kingdom late in the summer.

IMPORTS OF FRUIT INTO DENMARK

Home production of fruit in Denmark falls considerably short of consumption, and imports of apples have become so important in recent years that the size of the home crop is stated to have no very appreciable effect on the Copenhagen market.

The following table shows imports of the six principal fruits into Denmark in the six years 1927 to 1932.

Imports of Fruit into Denmark.

Description.	1927.	1928.	1929.	1930.	1931.	1932.
	tons.	tons.	tons.	tons.	tons.	tons.
Apples	21,885	14,535	18,580	14,775	19,940	10,005
Pears	4,170	2,950	3,420	2,270	5,330	1,175
Grapes	985	1,130	1,300	1,120	1,320	875
Oranges	8,385	8,915	8,840	10,740	10,380	10,360
Lemons	1,805	1,430	1,440	1,805	2,255	2,380
Bananas	5,660	6,480	6,480	8,960	10,070	6,850
Total	42,890	35,440	40,060	39,670	49,295	31,645

Total imports which had shown an increasing tendency over a number of years, culminating in record imports in 1931, suffered a sharp set-back in 1932 owing to declines in imports of apples, pears,

grapes and bananas. Imports of citrus fruit, on the other hand, although showing no further expansion, were up to the level of previous recent years. Last year's apple crop in Denmark was reported to be above average, which might account to some extent for the decline in imports of that fruit, but it is evident that other causes must have contributed to a drop of nearly 50 per cent. as compared with the previous year.

The United States supplies the largest proportion of the imports of apples. Of the total of 19,940 tons imported in 1931, which is the latest year for which details of imports are available, the United States supplied 11,510 tons, or nearly 60 per cent., Germany 4,100 tons, and fair quantities came from Switzerland, the Netherlands and other European countries. The British Empire's contribution was 680 tons from Australia and 490 tons from Canada, as compared with 675 tons and 390 tons respectively in the previous year. Re-exports of imported apples in 1931 totalled about 400 tons, and went mainly to Sweden and Germany.

Spain supplied 65 per cent. of the total imports of oranges and Italy only 15 per cent., but imports from Germany, which accounted for about 10 per cent. of the total imports, probably consisted for the most part of fruit of Italian origin. Imports from Palestine amounted to 690 tons, as compared with 300 tons in the previous year. The bulk of the lemons are imported from Italy, and Spain supplies by far the larger proportion of the grape imports. Germany was the principal source of supply of pears, total imports of which reached a record high level in 1931, and the bulk of the supplies from that country consisted no doubt, of re-exported fruit previously imported from other countries. The bulk of the imports of bananas are credited to the United Kingdom, Germany and the Netherlands, and consists of re-exported fruit, previously imported from other sources.

IMPORTS OF FRUIT INTO THE UNITED STATES

Although, as would be expected, imports of fruit into the United States fall some way behind exports on account of the enormous amount of fruit produced in that country, yet the import trade is of considerable importance, mainly owing to the large quantity of bananas handled each year. The total value of the fresh fruit imported into the United States in 1932 was about 27 million dollars, of which banana imports accounted for 25 millions. Exports of fresh fruit were valued at about 39 million dollars.

Imports of bananas showed a continuous increase for many years to 1929, in which year a total of over 65 million bunches was reached, but in each of the past three years there has been a decline, and in 1932 imports fell to about 49½ million bunches. This decline can be attributed mainly to the decreased demand arising from general economic conditions; there is no import duty on bananas entering the country.

Imports of lemons totalled nearly 700,000 cwts. in 1930, but fell to 179,000 cwts. in the following year, while in 1932 imports amounted to no more than 69,000 cwts.; the bulk of the lemons come from Italy. Imports of limes, which are mainly from Mexico and the West Indies, totalled about 37,000 cwts. last year, and showed some decline by comparison with preceding years. Cuba is the chief source of supply of imported grapefruit; aggregate imports, which reached about 108,000 cwts. in 1930, fell substantially during each of the two succeeding years, and amounted to 63,000 cwts. in 1932.

Apple imports are almost wholly from Canada and totalled 21,000 cwts. last year. Imports of grapes come mainly from Argentina, and, contrary to tendency of other fruit imports, have shown a progressive increase over the past six years, reaching a total of 53,000 cwts. in 1932. The weight of fresh pine-apples imported is not shown in the trade returns, but the value in 1932 is given as just over 900,000 dollars.

In Table I are shown particulars of the principal fresh fruit imports into the United States in the past six years.

TABLE I.—*Imports of Fruit into the United States.*

Description.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.
Bananas ..	61,009	64,308	65,134	62,731	55,834	49,457
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Lemons ..	561	623	419	698	179	69
Limes ..	44	46	41	49	51	37
Grapefruit..	8	68	64	108	80	63
Apples ..	64	44	105	62	14	21
Grapes ..	19	30	30	48	50	53

The chief source of supply of the bananas reaching the United States is the Republic of Honduras, from which country about 22 million bunches were imported annually between 1928 and 1931 ; figures for 1932 are not yet available. Jamaica has come next in order of importance in recent years, but the position in 1932 cannot yet be stated in the absence of complete figures. In 1927 Jamaica supplied only one million bunches less than Honduras, but in 1928 imports from Jamaica fell by over three million bunches, while those from Honduras increased by six millions. During the period from 1928 to 1931 imports from Jamaica remained fairly constant, averaging about 11 million bunches a year, but in 1932 the total fell to under 5 million bunches, and this decline accounted for almost the whole of the decrease in total imports of bananas into the United States during the year. Other sources of supply of bananas include Panama, Guatemala, Costa Rica and Nicaragua in Central America, Mexico, Cuba and Colombia, and no important variations are shown in the quantities coming from each of these countries during the years 1927-1931. Imports from Colombia in 1932, for which separate figures are available, show a substantial increase over the preceding season, but from Central America as a whole, and from Mexico, there was some decline. Over 500,000 bunches of bananas were imported from British Honduras in 1928, but in 1930 and in 1931 imports were no more than one-third of that amount.

A comparison between imports of bananas into the United States and into the United Kingdom in the past quarter of a century shows that the development of the banana trade in this country during the period has been relatively much more rapid. Imports into the United States in the peak year, 1929, were about 49 per cent. heavier than the yearly average during 1909-13, but in 1932 the increase was only 13 per cent. Imports into the United Kingdom in 1929 were two-and-a-quarter times as great as the 1909-13 average, but, in contrast with the decline which has occurred in the banana trade in the United States since that date, there has been a continued development in imports into this country, and in 1932 the total had risen to over two and a half times the average for the five years 1909-13.

Table II shows imports of bananas into the United States in each of the past six years.

TABLE II.—*Imports of Bananas into the United States*

Country from which consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.	Thousand bunches.
Jamaica ..	15,105	11,936	10,873	11,929	10,315	4,777
British Honduras	459	508	327	166	170	
Honduras Republic.	16,323	22,486	22,676	22,050	21,228	33,737 (a)
Panama ..	4,716	4,862	4,755	4,761	4,915	
Guatemala ..	6,503	6,251	7,260	5,079	4,091	
Costa Rica ..	5,273	4,632	4,126	3,228	3,342	
Nicaragua ..	2,330	3,398	3,989	3,672	2,621	
Mexico ..	5,721	5,526	5,700	6,505	5,164	4,549
Cuba ..	2,859	3,077	3,801	4,031	3,062	3,651
Colombia ..	1,630	1,619	1,534	1,233	890	2,666
Other countries	90	13	93	77	56	77
Total ..	61,009	64,308	65,134	62,731	55,854	49,457

(a) Details of imports from each country not yet available.

Details of imports of bananas into the United States and into the United Kingdom are given in round figures in Table III.

TABLE III.—*Imports of Bananas into the United States and into the United Kingdom*

Period.	United States.	United Kingdom.
<i>Five year Average.</i>	Bunches.	Bunches.
1909-13	43,700,000	6,700,000
1922-26	51,100,000	11,900,000
<i>Year.</i>		
1927	61,000,000	12,700,000
1928	64,300,000	13,000,000
1929	65,100,000	14,900,000
1930	62,700,000	15,000,000
1931	55,900,000	16,200,000
1932	49,500,000	17,100,000

The foregoing figures of imports into the United States do not include shipments of fruit to the mainland from the "non-contiguous" territories of Porto Rico and Hawaii, which form part of the United States. Substantial quantities of pineapples and grapefruit and smaller quantities of oranges, bananas and other fruits are shipped to the mainland from Porto Rico ; shipments of pineapples averaged about 360,000 cwts. a year during the six years 1927-32, while an average of 126,000 cwts. of grapefruit a year were shipped during the period. Bananas and pineapples are shipped to the mainland from Hawaii ; in 1927 shipments of bananas totalled over 200,000 bunches, but since then a gradual decline has occurred, and in 1932 shipments barely exceeded 90,000 bunches. Shipments of fresh pineapples from Hawaii are negligible by comparison with those from Porto Rico.

WEEKLY FRUIT INTELLIGENCE NOTES

The Empire Marketing Board's Weekly Fruit Intelligence Notes are issued on Wednesday in each week. They are compiled primarily for the benefit of growers and traders in the United Kingdom and in Empire countries overseas, and give the fullest possible information regarding supplies and prospective supplies of fruit. Regular articles include information as to fruit shipments afloat, imports week by week into each of the chief ports in Great Britain, imports of cut flowers and flower bulbs, and reports on the condition of fruit and vegetable crops in all countries where this information is of interest to the Empire grower. In addition, special articles deal with various aspects of fruit, flower and vegetable production, consumption and trade in all important areas.

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DAIRY PRODUCE SUPPLIES IN 1932

(Including Poultry and Pig Products)

PREPARED IN THE STATISTICS
AND INTELLIGENCE BRANCH OF
THE EMPIRE MARKETING BOARD



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FOREWORD

THE present volume, "Dairy Produce Supplies in 1932," reviews the trade in imported dairy produce, poultry and pig products for the past year and follows similar lines to the previous volume, "Dairy Produce Supplies in 1931," issued last year.

In addition to the comprehensive figures given for the United Kingdom, certain of the more important statistics of the external trade in dairy produce of other countries have also been included. These particulars for the past year are perhaps of special significance to Empire interests, as most of the large importing countries adopted drastic measures to curtail imports in 1932.

Most of the statistics given in this volume have already appeared in the Dairy Produce Notes, but here they have been brought together for convenience of reference. The trade figures for 1932 are in all cases provisional and subject to revision, but the amendments made when the Annual Statement of Trade of the United Kingdom is issued (generally towards the end of the year) are not, as a rule, important. Where such alterations have been made in the aggregate figures for earlier years, they have been carried into effect in the December totals of the monthly figures, but these alterations are of little significance.

STATISTICS AND INTELLIGENCE BRANCH,
EMPIRE MARKETING BOARD.

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IMPORT DUTIES ON DAIRY PRODUCTS

The following table gives the duties on dairy and allied products imported into the United Kingdom from foreign countries under the Import Duties Act, 1932, in operation on 1st March, 1932, and amended, where applicable, by the Ottawa Agreements Act, 1932, in operation on 17th November, 1932. The duties payable on imports from the Irish Free State, whether under the Import Duties Act, in operation on 15th November, 1932, or under the various Irish Free State (Special Duties) Orders are also given. The position is as at 1st May, 1933.

The effect of the duties on these commodities from foreign countries is difficult to gauge and the position is complicated by other factors working in the same direction, such as the depreciation of sterling. In the case of butter, the bulk of supplies is from countries on a sterling basis, while the effect of the duties in 1932 was offset by greater restrictions in alternative markets. The incidence of the duties combined with a depreciated sterling did affect imports of some commodities, notably eggs. Any change in total supplies, or of supplies from individual sources, which may be traced to the duties, is indicated in the sections which follow.

[*Note.*—The Ottawa Agreements Act continues, for three years from 15th November, 1932, the provisions in the Import Duties Act for the free entry into the United Kingdom of eggs, poultry, butter, cheese and other milk products from Canada, Australia, New Zealand, Newfoundland and Southern Rhodesia.]

Product.	Foreign Countries.	Irish Free State.
Milk	10 per cent. <i>ad valorem</i> ..	10 per cent. <i>ad valorem</i> .
Cream	10 per cent. <i>ad valorem</i> ..	40 per cent. <i>ad valorem</i> .
Butter	15s. per cwt.	40 per cent. <i>ad valorem</i> .
Cheese	15 per cent. <i>ad valorem</i> ..	10 per cent. <i>ad valorem</i> .
Milk, condensed, unsweetened, whole.	6s. per cwt.	10 per cent. <i>ad valorem</i> .
Milk, condensed, sweetened, whole.	5s. per cwt., in addition to any duty payable on sugar content.	10 per cent. <i>ad valorem</i> , in addition to any duty payable on sugar content.
Milk, condensed, sweetened, separated or skimmed.	10 per cent. <i>ad valorem</i> , or the sugar duty, whichever is the greater.	10 per cent. <i>ad valorem</i> , or the sugar duty, whichever is the greater.
Milk Powder, unsweetened..	6s. per cwt.	10 per cent. <i>ad valorem</i> .
Milk Powder, sweetened ..	10 per cent. <i>ad valorem</i> , or the sugar duty, whichever is the greater.	10 per cent. <i>ad valorem</i> , or the sugar duty, whichever is the greater.
Milk, preserved, other kinds, unsweetened.	6s. per cwt.	10 per cent. <i>ad valorem</i> .
Lactose (sugar of milk) ..	10 per cent. <i>ad valorem</i> ..	10 per cent. <i>ad valorem</i> .
Eggs in shell :—		
Not exceeding 14 lb. in weight, per great hundred.	1s. per great hundred ..	} 40 per cent. <i>ad valorem</i> .
Over 14 lb. but not exceeding 17 lb.	1s. 6d. per great hundred	
Over 17 lb. per great hundred.	1s. 9d. per great hundred	
Eggs not in shell	10 per cent. <i>ad valorem</i> ..	10 per cent. <i>ad valorem</i> .
Dressed poultry	10 per cent. <i>ad valorem</i> ..	40 per cent. <i>ad valorem</i> .
Live poultry	10 per cent. <i>ad valorem</i> ..	40 per cent. <i>ad valorem</i> .
Live pigs	Entry forbidden	40 per cent. <i>ad valorem</i> .
Bacon and ham	Free	30 per cent. <i>ad valorem</i> .
Fresh pork	Entry forbidden	30 per cent. <i>ad valorem</i> .
Frozen and salted pork ..	Free	30 per cent. <i>ad valorem</i> .
Lard	10 per cent. <i>ad valorem</i> .	10 per cent. <i>ad valorem</i> .

DAIRY PRODUCE SUPPLIES IN 1932

UNITED KINGDOM IMPORTS IN 1932

The United Kingdom easily maintained its position as the world's largest importer of dairy produce, pig and poultry products during 1932 and these commodities continued to comprise a large proportion of the nation's food bill, equal to 30 per cent. of the total imports of food, drink and tobacco. As in the two previous years, butter imports by value were greater than that of any other food commodity, but bacon lost to wheat its position as the second largest item.

The year 1932 was marked by a change in the fiscal policy of the United Kingdom, which brought most of the products dealt with in this review within the scope of the tariffs imposed on certain foreign goods in March, and of the revised rates introduced by the Ottawa Agreements Act. Whether as a result of these measures, the effects of which were combined, in many instances, with a depreciated sterling exchange, or of lower production following the drastic decline of prices during the past few years, the growing volume of imports of dairy and kindred products received a check in 1932. But imports of butter and bacon, by far the most important items, again established new records for quantity.

The continued decline in world prices, however, brought values for nearly every item below the previous year's level, and the total imports of dairy produce, pig and poultry products cost £18 millions less than in 1931. On the basis of declared values, the average price index for imported dairy products, with 1911-13 equalling 100, amounted to 84 in 1932, compared with an average of 141 in the three years 1924-26. For pig products the index was 86 in 1932 against 196 in 1924-26.

A feature of most of these imports in 1932 was the increased proportion supplied from Empire sources.

Table I overleaf shows, by quantity, the total imports of each of the principal dairy, pig and poultry products during the six years 1927 to 1932, compared with the averages for 1911-13 and 1924-26. The figures for the 1911-13 period include imports into what is now the Irish Free State and exclude imports into Great Britain and Northern Ireland from the Irish Free State, and are therefore not strictly comparable with the later years.

TABLE I.—Imports by Quantity of Dairy Produce, Poultry and Pig Products into the United Kingdom.

Commodity.	Average.		1927.	1928.	1929.	1930.	1931.	1932.
	1911-13(a).	1924-26.						
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Butter	4,149	5,653	5,819	6,113	6,397	6,822	8,060	8,449
Cheese	2,318	3,000	2,949	3,005	2,994	3,112	2,886	3,007
Milk, Fresh ..	6	55	84	100	56	49	83	55
Cream	9	80	125	148	139	136	179	136
Condensed Milk	1,210	2,283	2,520	2,673	2,651	2,602	2,799	2,739
Milk Powder (b)	46	152	165	234	284	267	366	333
	000 gt. hds.	000 gt. hds.	000 gt. hds.	000 gt. hds.	000 gt. hds.	000 gt. hds.	000 gt. hds.	000 gt. hds.
Eggs	19,908	21,423	24,340	26,466	24,964	26,541	25,925	19,977
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Egg Products ..	(c)	621	678	683	782	851	801	803
Poultry (dead) ..	(d) 262 000's.	360 000's.	506 000's.	490 000's.	554 000's.	570 000's.	665 000's.	519 000's.
Poultry (live) ..	(d) 878	1,325	1,322	1,182	1,204	1,092	1,145	876
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Bacon	4,787	7,610	8,482	8,853	8,278	9,191	11,134	11,406
Hams	903	1,449	889	942	1,029	1,003	831	803
Pork, Fresh ..	391	819	317	388	296	289	383	262
Pork, Frozen and Salted.	259	268	234	289	359	437	433	375
Lard	1,627 000's.	831 000's.	2,397 000's.	2,447 000's.	2,621 000's.	2,505 000's.	2,549 000's.	2,420 000's.
Live Pigs for Food.	—	188	395	318	311	415	479	303

(a) Figures for 1911-13 include imports into all Ireland from foreign countries and exclude imports into Great Britain and Northern Ireland from the Irish Free State.

(b) Including preserved milk, other kinds. (c) Not available.

(d) Average for 1912 and 1913 only.

Table II gives details of the imports of these products for the same period by value. The reservations attached to Table I apply with equal force to Table II.

TABLE II.—*Imports by Value of Dairy Produce, Poultry and Pig Products into the United Kingdom.*

Commodity.	Average.		1927.	1928.	1929.	1930.	1931.	1932.
	1911-13 (a)	1924-26.						
	000£.	000£.	000£.	000£.	000£.	000£.	000£.	000£.
Butter	24,346	50,378	48,205	52,045	54,706	46,870	46,298	41,481
Cheese	7,196	14,397	13,494	14,997	13,913	12,603	9,063	9,100
Milk, Fresh ..	3	32	36	59	36	31	54	34
Cream	35	431	667	796	702	629	748	530
Condensed Milk	2,140	5,223	5,040	5,250	4,786	4,315	4,337	3,602
Milk Powder (b)	87	564	522	729	823	718	756	645
Eggs	8,651	15,810	15,914	17,766	17,856	16,378	13,773	9,062
Egg Products ..	(c)	3,348	3,338	3,252	3,621	3,408	2,878	2,771
Poultry (dead) ..	(d) 881	2,070	2,757	2,688	2,960	2,881	3,126	2,338
Poultry (live) ..	(d) 38	224	223	197	222	184	194	115
Bacon	15,483	40,770	38,679	40,348	43,742	41,152	33,130	30,230
Hams	2,905	7,891	4,654	4,609	5,473	4,960	3,217	2,730
Pork, Fresh ..	1,044	4,042	1,348	1,550	1,298	1,242	1,259	729
Pork, Frozen and Salted.	349	1,161	912	1,014	1,306	1,642	1,283	981
Lard	4,142	8,939	7,585	7,505	7,807	6,853	5,911	4,800
Live Pigs for Food	—	1,159	2,337	1,890	1,944	2,619	2,213	1,036

(a) Figures for 1911-13 include imports into all Ireland from foreign countries and exclude imports into Great Britain and Northern Ireland from the Irish Free State.

(b) Including preserved milk, other kinds.

(c) Not available.

(d) Average for 1912-13 only.

IMPORTS OF FRESH MILK

The quantity of milk consumed as fresh milk in Great Britain was estimated at 946,900,000 gallons in the year ended 4th June, 1931. Compared with home production, imports of fresh milk are insignificant.

Imports of fresh milk into the United Kingdom, which had increased considerably in 1931, experienced a substantial decline in 1932, the total of 55,306 cwts., equal to about 601,000 gallons, being 33 per cent. less than in 1931. Imports from the Irish Free State, over 90 per cent. of which consists of trade across the land boundary, were reduced by 27 per cent.

Imports from foreign countries, apart from relatively large increases in 1927 and 1928, have been negligible in recent years and were entirely absent in 1929 and 1930. Towards the end of 1931 a temporary shortage of milk in England caused a certain importation from foreign countries, a movement which continued into the early part of 1932. During the past winter there was no such importation and imports from Continental countries in 1932 were about one-third of the 1931 aggregate.

Total imports of fresh milk from 1926 to 1932 were as follows :—

TABLE I.—*Imports of Fresh Milk, 1926-32.*

Year.	From the Irish Free State.	From Other Countries.	Total.
	cwts.	cwts.	cwts.
1926	73,415	184	73,599
1927	80,985	2,859	83,844
1928	90,140	9,623	99,763
1929	56,054	—	56,054
1930	49,259	—	49,259
1931	69,653	13,457	83,110
1932	50,589	4,717	55,306

Table II shows the quarterly imports of fresh milk into the United Kingdom throughout 1931 and 1932 and the countries from which they were consigned.

TABLE II.—*Quarterly Imports of Fresh Milk into the United Kingdom.*

Period.	1931-32.						Total.
	Irish Free State.	Channel Islands.	Foreign Countries.				
			Denmark.	Netherlands.	France.	Norway.	
<i>1931.</i>	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Jan. to Mar. ..	10,499	—	—	—	—	—	10,499
Apr. to June ..	9,187	—	—	—	—	—	9,187
July to Sept. ..	14,128	—	—	—	—	—	14,128
Oct. to Dec. ..	35,839	—	1,700	8,944	1,831	982	49,296
Total ..	<i>69,653</i>	—	<i>1,700</i>	<i>8,944</i>	<i>1,831</i>	<i>982</i>	<i>83,110</i>
<i>1932.</i>							
Jan. to Mar. ..	10,485	—	—	1,541	—	3,022	15,048
Apr. to June ..	14,720	75	—	—	—	—	14,795
July to Sept. ..	12,017	34	—	—	—	—	12,051
Oct. to Dec. ..	13,367	45	—	—	—	—	13,412
Total ..	<i>59,589</i>	<i>154</i>	—	<i>1,541</i>	—	<i>3,022</i>	<i>55,306</i>

IMPORTS OF CREAM

The output of cream in Great Britain, including sales off farms and by creameries, etc., but excluding quantities consumed in farm households, amounted in 1930-31 to rather over 3,500,000 gallons, as compared with 3,100,000 gallons in 1924-25. Imports of cream increased from comparatively small proportions to a peak in 1928. Following a reduction in supplies in the two following years the 1931 figure was the largest ever recorded, but the total of 136,475 cwts. imported in 1932 was 24 per cent. below the previous year's figure.

The Irish Free State remained the principal source of imported cream during 1932, but supplied 8 per cent. less than in 1931. Imports across the land boundary accounted for less than 6 per cent. of supplies from the Irish Free State, compared with 9 per cent. in 1931 and an average of 14 per cent. in the five years 1926 to 1930.

Imports from foreign sources, which consist mainly of tinned cream, were reduced by 36 per cent. in 1932, thus checking the rapid upward movement which has been a feature of the past decade. Imports from Denmark declined by 8 per cent., but supplies from all other foreign countries were reduced to a fraction of the previous year's figures and in certain instances were almost entirely absent. The decrease was particularly marked in the case of imports from the Netherlands, which fell from 28,000 cwts. to under 3,000 cwts.

Empire supplies, practically confined to the product of the Irish Free State, comprised 54 per cent. of imports of cream by weight in 1932, compared with 45 per cent. in 1931.

Exports of imported cream are comparatively negligible, although the quantity re-exported in 1931 was above the level of recent years. Re-exports in 1932, totalling 1,156 cwts., were 2,138 cwts. less than in the previous year.

Table I gives details of the imports of cream in the six years 1927 to 1932.

TABLE I.—*Imports of Cream into the United Kingdom.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Irish Free State	91,253	87,716	76,586	67,119	79,463	73,149
Other Empire Countries	35	63	64	36	10	—
Denmark	18,496	34,611	39,484	46,993	65,708	60,229
Netherlands	8,578	15,678	14,324	13,470	28,023	2,775
Switzerland	4,601	5,889	7,030	6,850	4,254	5
Norway	668	1,842	620	566	894	61
Germany	(a)	1,193	434	679	759	238
Other Foreign Countries	1,180	1,300	62	243	124	18
Total Empire Countries ..	91,288	87,779	76,650	67,155	79,473	73,149
Total Foreign Countries..	33,523	60,513	61,954	68,801	99,762	63,326
Total All Countries	124,811	148,292	138,604	135,956	179,235	136,475
<i>Re-exports</i>	584	1,008	810	1,334	3,294	1,156
Net Imports	124,227	147,284	137,794	134,622	175,941	135,319

(a) Included in "Other Foreign Countries".

TABLE II.—*Monthly Imports of Cream into the United Kingdom (a)*

Month.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	9·8	6·8	6·7	7·6	9·1
February ..	10·0	7·2	6·9	7·0	14·2
March ..	12·9	6·0	7·7	8·7	9·6
April ..	11·1	10·2	9·8	11·8	8·9
May ..	11·6	11·7	14·2	15·9	13·0
June ..	13·8	10·2	15·5	17·3	18·6
July ..	16·4	19·3	17·5	24·8	21·5
August ..	16·4	14·7	12·5	19·3	13·5
September ..	9·9	10·9	9·5	12·2	8·6
October ..	9·7	11·0	9·9	12·7	5·3
November ..	8·1	7·3	7·5	20·0	5·2
December ..	6·5	14·1	10·5	14·4	4·9
Total	136·2	129·4	128·2	171·7	132·4

(a) Excluding imports from the Irish Free State across the land boundary.

TABLE III.—*Monthly Imports of Cream into the United Kingdom during 1931*

Month.	Irish Free State. (a)	Denmark.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	4·8	3·4	0·9	9·1
February	5·2	7·7	1·3	14·2
March	5·0	4·3	0·3	9·6
April	5·5	3·3	0·1	8·9
May	7·3	5·7	—	13·0
June	9·8	8·5	0·3	18·6
July	12·6	8·9	—	21·5
August	6·3	7·2	—	13·5
September	4·5	3·9	0·2	8·6
October	3·1	2·2	—	5·3
November	2·3	2·9	—	5·2
December	2·7	2·2	—	4·9
Total	69·1	60·2	3·1	132·4

(a) Excluding imports across the land boundary.

Imports of cream are heaviest during the summer months and lightest in winter. In the first quarter of 1932 the rate of importation was greater than a year earlier and a proportion of the imports at that time consisted of fresh cream, following a shortage of home supplies. Thereafter a decline set in and towards the end of the year imports were much smaller than in 1931. At the same time, imports in the last few months of 1931 had been well above the average for that period of the year.

Table II gives the monthly imports of cream into the United Kingdom during the past five years, excluding imports from the Irish Free State across the land boundary.

Table III shows the monthly imports of cream from each of the principal sources in 1932, imports across the land boundary being again excluded.

THE BUTTER MARKET IN 1932

The year 1932 as it affected international trade in butter, was marked by considerable changes and adjustments, the result of several factors complex in themselves and combining to upset the trends of recent years. But the evidence would appear to suggest that world production of butter in 1932 was less than in 1931, and certainly the quantities entering world trade, which had been steadily expanding in recent years, suffered a reduction, probably in the region of 5 to 6 per cent. Decreasing production, an inevitable consequence of the continued depression in prices, was particularly noticeable in European exporting countries and was reflected in reduced exports. In the Southern Hemisphere, on the other hand, and particularly in Australia and New Zealand, where weather conditions play a predominant part, a further good season, aided by favourable exchange differences, resulted in production surpassing previous records. A third feature which characterised the butter trade in 1932 was the important part assumed by legislation, introduced by all the chief importing countries and designed to restrict the growing importations of butter; in particular, the introduction of the quota method of limitation. The effect of these measures more than offset the influence of the tariff and a depreciated sterling, and the United Kingdom's share of the world's trade in butter increased; it is estimated that more than three-quarters of total world imports in 1932 were taken by this country, as against about 70 per cent. in 1931.

Total imports of butter into the United Kingdom in 1932 amounted to 8,449,126 cwts., or nearly 5 per cent. above the record 1931 figure and 24 per cent. greater than in 1930. With the decline in re-exports, net imports were nearly 6 per cent. greater than in 1931.

The production of farm butter in Great Britain in the year ended 4th June, 1931, was estimated at 702,800 cwts. and the production of creamery butter, in 1930, according to the Census of Production, at about 94,400 cwts. The total production of butter in Northern Ireland in 1930-31 was 166,500 cwts. If the total figure of 963,700 cwts. so calculated be taken as representing butter production in the United Kingdom both in 1931 and in 1932, and the consumption of imported butter in 1932 was 7,700 tons per week (*see* page 31), then the *per capita* consumption of butter in the United Kingdom in 1932 was approximately 21·8 lb., compared with 20·9 lb. in 1931 and an average of 15·6 lb. in the four years 1924 to 1927.

Sources of Supply.—Denmark maintained its position as chief source of butter imported into the United Kingdom, sending 5 per cent. more than in 1931, and accounting for approximately 31 per cent. of total imports, or the same proportion as in the two previous years. More striking, however, was the increase in imports from New Zealand and Australia, the former, with well over 2 million cwts., increasing its supplies by 14 per cent. to comprise 26 per cent. of total imports against 24 per cent. in 1931; imports from Australia increased by 15 per cent. and accounted for 22 per cent. of the total, compared with 19 per cent. in the previous year.

Fourth place was occupied by Argentina, an increase of 4 per cent., mainly in the earlier months of the year, enabling that country to supplant Russia and the Irish Free State. Imports from the Irish Free State have fallen off each year since 1929 and the 1932 figure was 17 per cent. less than in 1931. Russian supplies, which had shown a considerable expansion in 1931, declined by 20 per cent. in the past year. Marked decreases occurred in imports from Finland, Sweden and Estonia; supplies of Dutch butter were less than one-half of the 1931 figure, while imports from Poland were reduced to a negligible quantity. On the other hand, there was a substantial increase in supplies of Latvian butter at the expense of the German market and a further advance in imports from Lithuania.

Imports from Canada, following a large increase in 1931, were materially reduced, and slightly smaller quantities were received

from South Africa, but a feature was the appearance of South West Africa as a source of supply.

TABLE I.—Imports of Butter into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
New Zealand	252	1,252	1,222	1,304	1,564	1,926	2,223
Australia	594	489	873	768	951	1,558	1,796
Irish Free State	(a)	587	559	566	522	381	315
Canada	1	—	2	—	—	78	19
Union of South Africa ..	—	—	—	12	25	40	37
South West Africa Territory.	—	—	—	—	1	—	22
Kenya	(b)	(b)	(b)	1	6	6	7
Other Empire Countries ..	1	1	1	1	1	1	2
Denmark	1,707	1,995	2,016	2,204	2,319	2,466	2,584
Russia	751	351	336	290	165	404	323
Finland	(c)	205	199	234	234	254	217
Sweden	332	166	176	248	280	212	176
Latvia	(c)	38	50	81	49	39	113
Estonia	(c)	60	78	110	96	125	83
Lithuania	(c)	1	1	13	21	40	68
Netherlands	153	170	129	130	89	96	47
Poland	(d)	15	29	69	65	33	3
Norway	20	—	—	6	2	13	15
Germany	—	1	3	10	8	8	4
France	249	66	70	45	7	1	2
Argentina	73	420	366	303	414	374	390
United States of America	—	1	2	—	—	1	—
Other Foreign Countries..	6	1	1	2	3	4	3
Total Empire Countries ..	848	2,329	2,657	2,652	3,070	3,990	4,421
Total Foreign Countries ..	3,291	3,490	3,456	3,745	3,752	4,070	4,028
Total All Countries ..	4,139	5,819	6,113	6,397	6,822	8,060	8,449

(a) Not separately distinguished before April, 1923.

(b) Included in "Other Empire Countries."

(c) Included in Russia.

(d) Included in Russia, Germany and Austria-Hungary.

Largely as a result of the increased quantities from Australia and New Zealand, supplies of Empire butter in 1932 increased by 11 per cent., and accounted for 52 per cent. of total imports, as against just under 50 per cent. in 1931; this is the largest proportion ever recorded.

Table I gives details of the imports of butter in 1913, and the six years 1927 to 1932.

In this and subsequent tables of a similar type the particulars refer to the country from which the goods were consigned (i.e. the place from which they were procured by the importer), and not necessarily to the country of origin. But from an inquiry conducted by the Board of Trade during 1931, it is apparent that, in the case of butter, the country whence consigned is nearly always also the country of origin.

Seasonal Variation.—During the first three months of 1932 imports were on a heavier scale than a year earlier, due largely to increased Southern Hemisphere supplies. In the following quarter, however, Australian entries were reduced and total imports fell below the previous year's figures. In the first six months of the year imports were 5 per cent. greater than a year earlier, although the quantity from Southern Hemisphere sources increased by 10 per cent. The normally large importation in July hardly reached the record July, 1931, level. In the two following months imports again exceeded those of the same period in 1931. A decline occurred in October, but increasing supplies from the Southern Hemisphere and heavy imports from Denmark culminated in a record December figure. Imports were lightest in April, or one month later than in 1931.

Table II shows the monthly imports of butter in 1913 and the seven years 1926 to 1932.

Table III, which shows the monthly imports of butter from the chief sources in 1932, indicates the complementary nature of Southern and Northern Hemisphere supplies, although the actual variation in arrivals from the chief sources is not great. The light importation in early summer was due to the falling off in Southern supplies before European production had begun properly to show a seasonal expansion. The unusually rapid expansion in supplies from Australia and New Zealand accounted for the heavy imports in December.

TABLE II.—*Monthly Imports of Butter into the United Kingdom*

Month.	1913.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	365	673	476	527	602	643	675	711
February ..	350	431	371	583	483	524	597	728
March ..	303	468	549	624	606	567	563	656
April ..	371	536	427	462	605	584	671	599
May ..	326	468	554	478	636	604	723	695
June ..	364	528	680	632	611	687	757	782
July ..	462	562	611	606	603	541	808	805
August ..	335	465	465	585	527	542	658	693
September ..	328	429	463	327	372	497	597	696
October ..	270	412	383	413	375	515	641	565
November ..	307	397	401	442	448	463	597	675
December ..	358	450	439	434	529	655	773	844
Total ..	4,139	5,819	5,819	6,113	6,397	6,822	8,060	8,449

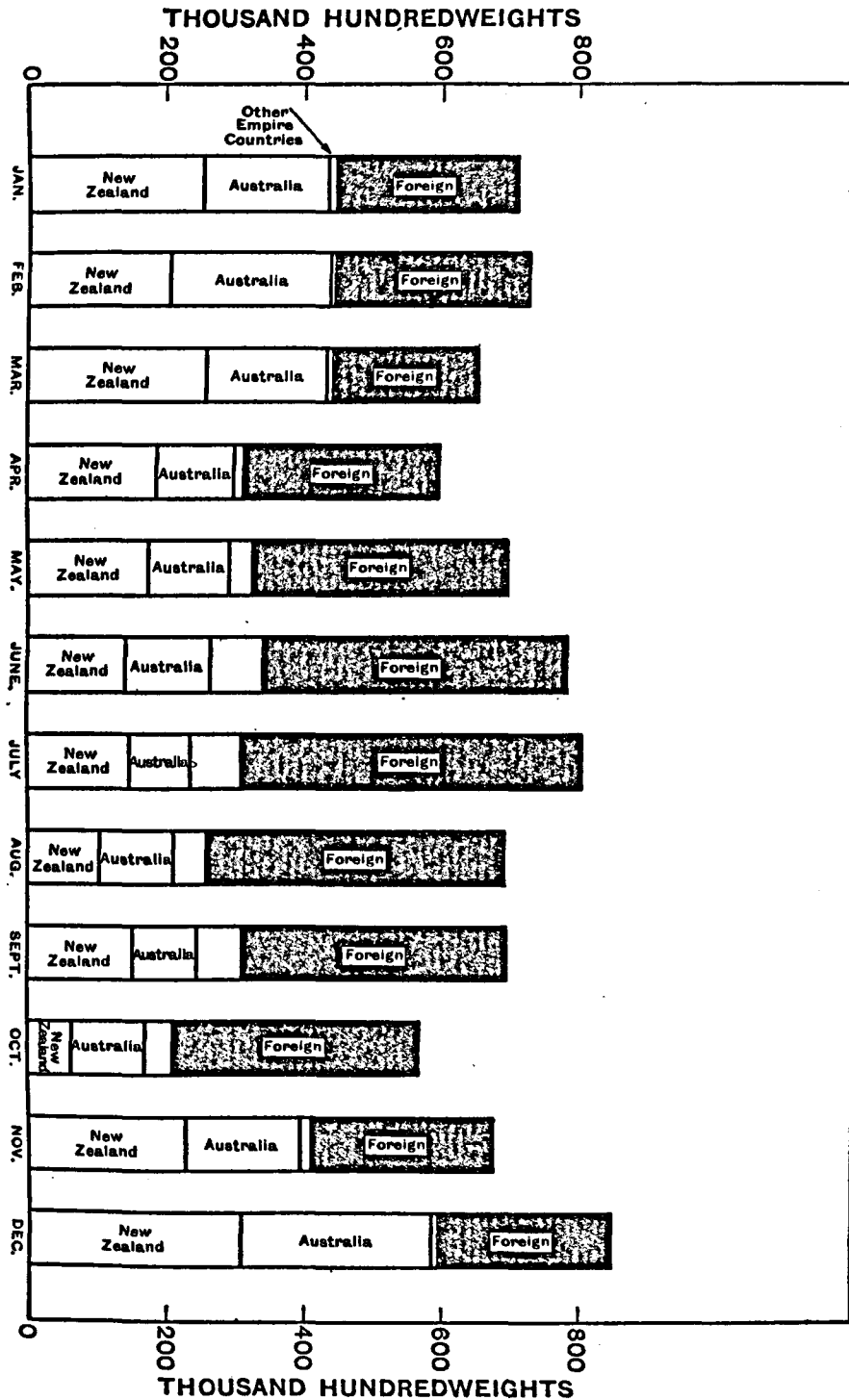
TABLE III.—*Monthly Imports of Butter from Chief Countries of Consignment in 1932*

Month.	Aus- tralia.	New Zea- land.	Irish Free State.	Den- mark.	Sweden, Norway, Finland.	Russia and Baltic Countries ^(a)	Argentina.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	183	256	2	174	34	5	52	5	711
February ..	233	207	2	179	43	1	58	5	728
March ..	177	259	1	145	20	1	45	8	656
April ..	112	186	2	183	37	16	46	17	599
May ..	119	174	30	256	43	21	41	11	695
June ..	122	141	65	286	31	89	29	19	782
July ..	89	149	66	268	42	151	20	20	805
August ..	114	102	37	260	43	106	14	17	693
September ..	90	155	57	220	39	106	16	13	696
October ..	108	61	39	214	29	80	22	12	565
November ..	169	226	13	202	21	10	22	12	675
December ..	280	307	1	197	25	4	25	5	844
Total ..	1,796	2,223	315	2,584	407	590	390	144	8,449

(a) Estonia, Latvia, Lithuania and Poland.

Fig. 1 shows the monthly imports of butter in 1932 from Empire and foreign sources.

FIG. 1. MONTHLY IMPORTS OF EMPIRE AND FOREIGN BUTTER IN 1932



EXPORTS OF IMPORTED BUTTER

The large increase in exports of imported butter from the United Kingdom, which occurred in 1931, was not maintained in 1932, when a decline of 12 per cent. was recorded. In the early part of the year re-exports were on a much higher level than a year previously, the increase in the first six months amounting to 35 per cent. Thereafter, the effect of quota restrictions in European countries was felt in reduced shipments, with a particularly marked decline in December.

The reduction in re-exports in the past year was due mainly to light supplies to France, which took less than half as much as a year earlier. Belgium and Germany, the principal markets, showed little change from 1931, and supplies to Switzerland were maintained; larger quantities were taken by the Netherlands, mainly in the first few months of the year. Shipments to the Irish Free State continued the declining trend of recent years and reduced quantities were sent to Canada.

Details of the exports of imported butter in 1913 and 1927 to 1932 are given in Table IV.

TABLE IV.—*Re-exports of Butter from the United Kingdom*

Destination.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Irish Free State	(a)	38·0	48·2	35·5	29·1	26·4	19·0
Canada	6·6	23·0	1·7	19·1	2·8	7·8	4·0
Other Empire Countries..	25·9	21·1	16·0	14·3	18·5	22·1	28·5
Belgium	18·9	14·2	12·2	14·2	16·3	66·4	66·1
Germany	2·1	27·6	18·6	5·3	45·7	59·6	61·9
Netherlands	21·5	20·2	19·7	13·8	26·2	46·9	57·6
France	7·0	41·9	19·2	12·6	13·9	95·0	43·7
Italy	3·7	2·1	4·8	—	1·9	6·0	(b)
Switzerland	(b)	10·5	13·3	5·6	9·7	15·7	15·8
United States of America	13·1	29·0	7·0	0·2	1·4	0·4	(b)
Other Foreign Countries	6·9	9·4	3·8	2·1	7·7	5·1	11·0
Total Empire Countries ..	32·5	82·1	65·9	68·9	50·4	56·3	51·5
Total Foreign Countries ..	73·2	154·9	98·6	53·8	122·8	295·1	256·1
Total All Countries ..	105·7	237·0	164·5	122·7	173·2	351·4	307·6

(a) Not separately recorded.

(b) Included in "Other Foreign Countries".

PRICES

The downward trend of butter prices, as of world agricultural prices in general, continued in 1932, and the average level of quotations on the British market was below that of 1931, although the fall was less pronounced than in either of the two preceding years.

At the end of 1931, box butter prices had sunk to the lowest level of that year. After a further decline in the middle of January, prices experienced an upward movement, due partly to increased Continental demand, partly to light available supplies and later aided by the announcement of proposed tariff rates on foreign butter. Values were maintained until the middle of April, when the previous year's corresponding prices were reached for one week. Thereafter, heavier supplies brought prices down over a period of six weeks. From the beginning of June a gradual upward tendency was recorded, prices for box butter reaching a peak in September, at which point the preceding year's corresponding prices were again attained. In the last quarter of the year, however, the rapidly expanding Southern Hemisphere season, surpassing previous records, and the consequent increase in shipments, caused a rapid and continuous decline until the middle of December, when New Zealand finest salted, at 83s., touched the lowest price for thirty years. The year closed with a rather steadier tendency, although prices were only slightly above the minimum.

Danish prices at the end of 1931 were at a fairly high level as a result of light supplies. In the first few weeks of 1932 prices fell continuously, but for four weeks from the end of January light supplies accentuated by labour troubles caused a rapid increase which culminated in a peak of 156s., or almost equal to the highest point reached in 1931. A precipitate fall, only occasionally interrupted, then ensued until, at the end of June, the lowest point of 100s. was recorded, and the spread between Danish and New Zealand butter prices on the British market was less than a year earlier. A sharp increase in July to the previous year's level was followed by a decline at the end of the month, but prices again recovered from the end of August until the middle of September. A gradual decline for a month was followed by an increase and prices were well maintained, although appreciably under the 1931 level, until the last week of the year. Towards the end of 1932 the spread between Danish and box butter prices became very pronounced, slightly exceeding the difference noted a year earlier.

Average prices for 1932 showed a drop of 10 per cent. for New Zealand and Australian finest salted butter, compared with 1931, and a reduction of 8½ per cent. in the case of Danish, these declines following an all-round drop of about 13 per cent. between 1930 and 1931. Between 1929 and 1932, New Zealand butter declined in price by 41 per cent. and Danish by 35 per cent.

Monthly prices of these, the three most important kinds of butter on the United Kingdom market, are given for 1930, 1931 and 1932 in Table V. The figures are taken from the weekly quotations of the London Provision Exchange, and represent the average of the highest weekly quotations during the month.

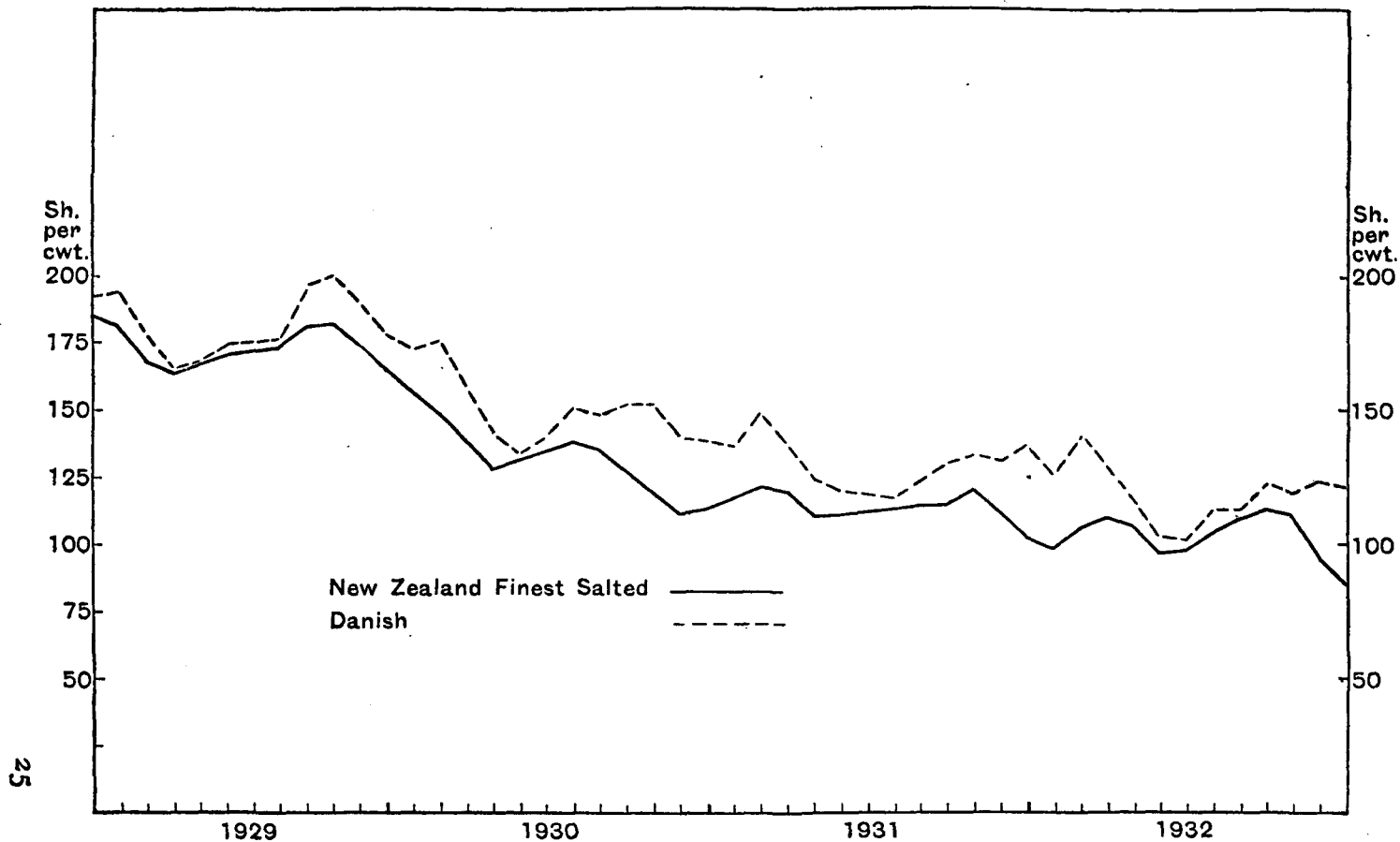
Figure 2 shows in diagrammatic form the trend of prices for New Zealand and Danish butter from 1929 to 1932.

TABLE V.—Average Price of Butter at London

Month.	New Zealand Finest Salted.			Australian Finest Salted.			Danish.		
	1930.	1931.	1932.	1930.	1931.	1932.	1930.	1931.	1932.
	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>	Per cwt. <i>s. d.</i>
January	156 9	117 0	99 6	153 6	112 3	98 9	173 6	135 9	125 3
February	149 6	121 9	106 9	146 0	119 6	104 3	175 6	148 6	143 0
March	137 0	118 3	110 0	133 9	117 9	105 6	158 6	137 0	126 6
April	128 0	110 9	106 9	125 0	108 9	105 3	140 0	124 0	116 9
May	130 9	110 6	97 0	129 0	107 9	96 9	134 0	119 9	104 3
June	134 0	112 0	97 6	130 3	107 6	96 6	139 6	119 3	101 9
July	137 0	113 6	104 3	134 6	108 6	101 6	150 6	118 6	112 6
August	134 6	114 3	109 3	133 0	110 0	102 6	149 3	124 6	113 3
September	128 0	114 6	113 9	126 6	108 9	106 6	151 6	130 9	123 6
October	118 0	121 0	110 3	114 6	115 3	100 6	151 3	134 0	119 0
November	110 6	113 0	94 6	106 6	107 9	89 9	139 6	132 0	123 9
December	112 0	103 6	84 6	108 9	102 6	84 6	138 0	137 0	121 6
Average	131 3	114 3	103 0	128 6	110 6	99 6	150 0	130 0	119 0

Average monthly prices for certain other types of imported butter are given in Table VI, the prices being from the weekly quotations

FIG. 2. PRICES OF NEW ZEALAND AND DANISH BUTTER AT LONDON, 1929-32



of the London Provision Exchange, except Swedish and Finnish, for which the prices issued by the Manchester Wholesale Provision Association are adopted; both these descriptions move in a somewhat similar manner to Danish, but at a slightly lower level. Dutch creamery unsalted butter, the dearest imported type, was in unusually short supply in the first few months of 1932 and realised a substantial premium.

TABLE VI.—Average Monthly Prices of Butter during 1932

Month.	New Zealand Finest Unsalted.	Australian Finest Unsalted.	Swedish. ‡	Argentine Finest Unsalted.	Dutch Creamery Unsalted.	Estonian Salted.	Finnish. ‡	Russian (Siberian).	Latvian Salted.
	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.
January ..	114 9	109 3	121 0	99 3	153 3	—	120 6	—	—
February ..	115 0	109 0	130 6	105 0	164 0	—	128 9	—	—
March ..	118 0	109 0	124 6	107 6	139 0	—	123 6	—	—
April ..	113 6	105 6	117 9	101 3	132 0	—	117 6	101 3	—
May ..	99 6	96 9	107 0	90 6	119 6	—	106 9	93 0	—
June ..	101 0	96 9	101 9	89 0	125 6	90 0	103 0	90 3	90 9
July ..	107 3	104 6	110 6	90 6	122 9	91 9	112 0	88 6	91 6
August ..	109 6	108 0	109 6	88 6	114 6	90 6	111 3	86 0	90 0
September ..	114 0	108 3	117 0	91 6	121 6	96 0	120 9	89 0	97 3
October ..	112 6	104 3	113 0	92 0	122 0	94 9	113 3	89 9	95 0
November ..	108 6	94 6	121 9	89 0	125 3	95 0	121 9	86 0	96 0
December ..	95 6	88 6	117 0	86 6	124 0	—	120 0	—	—

‡ Official quotations of the Manchester Wholesale Provision Association.

Home-produced butter has shared in the fall in prices during the past few years, although to a slightly less extent than imported descriptions. The price to the producer, representing the average quotations for first quality butter at county markets in England and Wales as published by the Ministry of Agriculture, averaged 1s. 4½d. per lb. in 1932, a drop of about 6 per cent. compared with 1931. Between 1929 and 1932 the average price of home-produced butter at these markets declined by 33 per cent., as compared with a fall of 41 per cent. for New Zealand butter and 35 per cent. for Danish.

Prices for home-produced butter tend to vary seasonally with production rather than with imported supplies. The highest price for the year of 1s. 7½d. was reached in January and the lowest of 1s. 1½d. in June. The highest and lowest in 1931, also occurring in these months, were 1s. 7¼d. and 1s. 2¼d., respectively.

Table VII shows the average monthly prices for first quality farm butter at country markets in England and Wales in the four years 1929 to 1932.

TABLE VII.—Average Price of First Quality Butter at Country Markets in England and Wales

Month.	1929.		1930.		1931.		1932.	
	Per lb.		Per lb.		Per lb.		Per lb.	
	s.	d.	s.	d.	s.	d.	s.	d.
January	2	1	1	11½	1	7¼	1	7
February	2	0½	1	11	1	7½	1	6½
March	2	0½	1	9½	1	7½	1	5½
April	1	10½	1	7½	1	5½	1	5
May	1	7½	1	4½	1	3	1	3
June	1	6½	1	4½	1	2½	1	1½
July	1	8	1	6½	1	3½	1	2½
August	1	10	1	7	1	4½	1	3½
September	1	10½	1	7	1	4½	1	3¼
October	2	0	1	6½	1	5	1	3½
November	2	0	1	6½	1	5½	1	4½
December	2	0½	1	7½	1	7	1	5½
Average for Year ..	1	10½	1	7½	1	5½	1	4½

COLD STORAGE HOLDINGS AND APPARENT CONSUMPTION OF IMPORTED BUTTER

With the co-operation of cold-store proprietors and traders, the Empire Marketing Board arranged for the collection and publication on a voluntary basis of stocks of butter in cold storage at fortnightly intervals, commencing from December, 1929. Returns so furnished are estimated to include approximately 95 per cent. of all the butter in cold storage in Great Britain and are thus capable of affording a sufficiently reliable indication of the movement of stocks as a whole. It should be noted that the figures do not include stocks in steamers in process of discharging, nor stocks in ordinary storage. It is not considered that the omission of these latter "invisible" stocks

seriously affects the figures over a fairly long period, particularly in the past few years, when buying has been largely confined to the fulfilment of immediate requirements.

Imports of butter into the United Kingdom in the first half of the year are normally heavier than in the second six months, and there is a consequent movement into cold storage until the summer months, to allow for the period when supplies are usually short. The growing importance of Southern Hemisphere supplies, however, and their extension beyond the accustomed seasonal limits, appears to have lessened this tendency within the past year or two. Stocks in 1931 did not attain a maximum until August, or a month later than in the previous year, due largely to a prolonged Southern Hemisphere season. In 1932 the peak was a week or two earlier than in 1931. The same factor operates at the end of the year, and at the close of 1931 and 1932, stocks were in each case heavier than in the preceding year. The Board's figures are of too recent development to permit of generalisations being made, but the tendency in the past few years appears to be towards less violent seasonal fluctuations in the stock position, both the maxima and minima becoming less marked.

Stocks in store at the beginning of 1932 were heavier than a year earlier and, in spite of a net outward movement in February, continued in excess of the 1931 level until the middle of May. From then until the peak in July stocks corresponded to those of a year previously. At their highest point, stocks in store were the equivalent of 177,000 boxes less than the previous year's peak and 318,000 boxes below the peak of 1930. From then until the middle of October stocks were lighter than in 1931, in spite of a heavier rate of importation. A reduction was also recorded in November, but the large December imports brought the quantity in store at the end of the year well above the figure of the preceding year.

In view of the fact that the increased imports in 1932 occurred mainly in box butter, it is noteworthy that the stock position for this description compared favourably with 1931 and did not reach that year's peak. Stocks of cask butter in cold storage are negligible until early summer. Stocks in 1932 did not reach the large figure recorded in 1931, but ran at a much higher level than in 1930; from the end of August until early October, more than 50 per cent. of the stocks in storage consisted of cask butter.

The movement of cold storage stocks of butter in 1930, 1931 and 1932 is shown in Table I in fortnightly periods. Figure 3 gives similar details for box, cask and all butter in diagrammatic form.

FIG. 3. STOCKS OF BUTTER IN COLD STORAGE IN GREAT BRITAIN

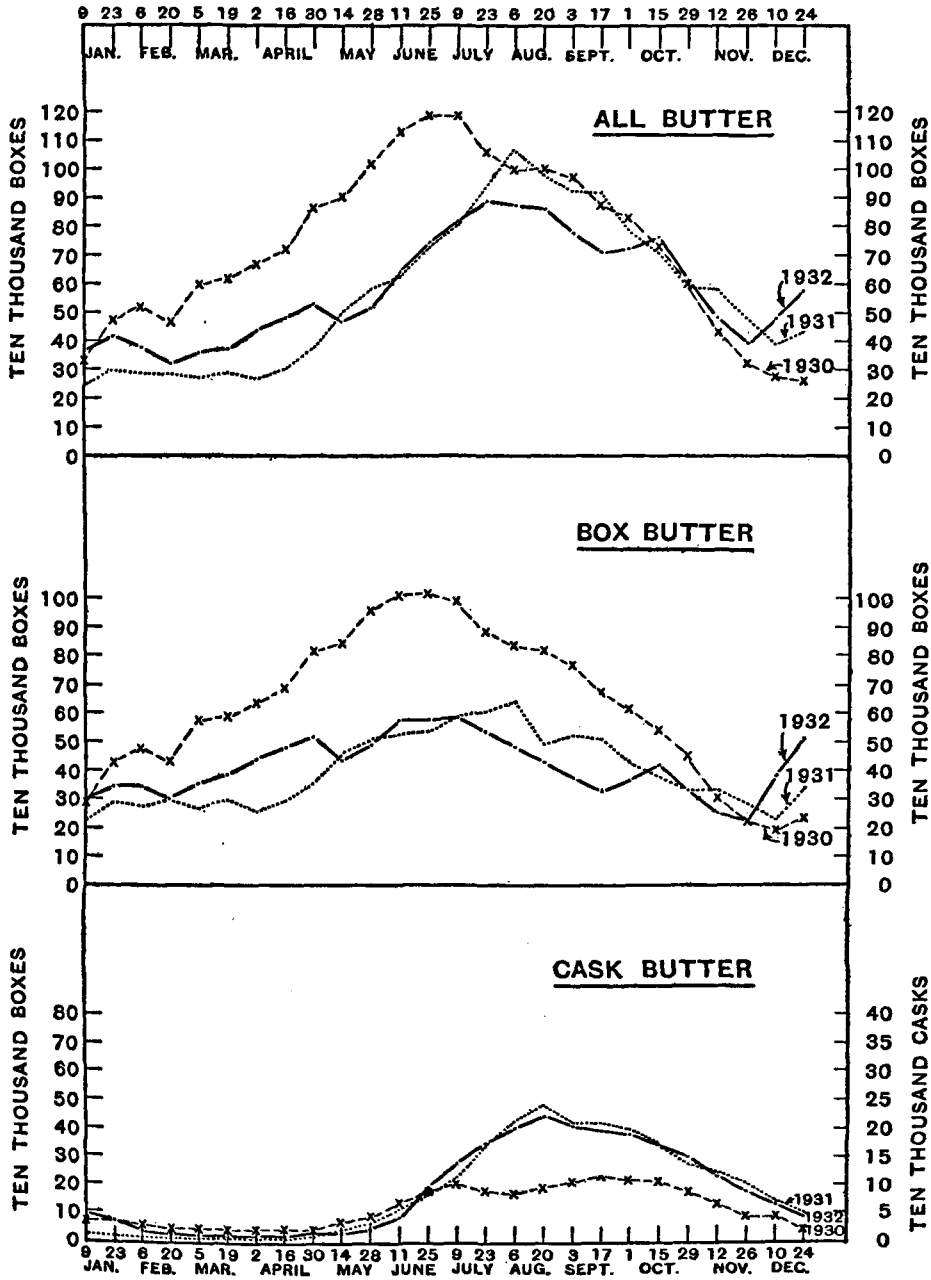


TABLE I.—Stocks of Butter in Cold Storage in Great Britain

Date (1931).	1930.			1931.			1932.		
	Boxes.	Casks.	Total (a) (as boxes)	Boxes.	Casks.	Total (a) (as boxes)	Boxes.	Casks.	Total (a) (as boxes)
	000.	000.	000.	000.	000.	000.	000.	000.	000.
January 10th ..	268	28	325	211	12	235	286	38	364
January 24th ..	411	26	464	283	9	303	346	28	403
February 7th ..	458	25	509	267	6	281	344	13	373
February 21st ..	418	21	462	293	3	301	296	7	311
March 7th ..	561	20	601	260	3	267	348	4	358
March 21st ..	588	16	622	285	2	291	372	4	382
April 4th ..	631	15	662	244	3	251	437	4	448
April 18th ..	692	17	728	286	5	298	474	4	484
May 2nd ..	810	21	853	350	6	363	504	12	529
May 16th ..	842	31	905	454	15	485	435	12	460
May 30th ..	949	40	1,031	503	28	560	479	19	518
June 13th ..	1,001	64	1,131	513	53	621	559	43	646
June 27th ..	1,015	89	1,194	537	89	716	558	88	736
July 11th ..	984	101	1,188	579	109	798	562	131	825
July 25th ..	880	90	1,062	593	164	923	539	168	876
August 8th ..	835	84	1,004	629	211	1,053	473	197	870
August 22nd ..	810	95	1,002	496	242	981	425	216	861
September 5th ..	764	101	968	516	202	921	371	200	775
September 19th ..	663	111	888	500	206	913	333	190	716
October 3rd ..	606	110	829	421	183	787	356	183	727
October 17th ..	534	104	743	381	171	725	409	170	752
October 31st ..	450	81	614	313	139	592	320	146	614
November 14th ..	303	67	438	328	125	578	249	111	473
November 28th ..	244	38	320	268	106	481	222	84	392
December 12th ..	186	45	276	243	72	389	357	59	478
December 26th ..	216	17	252	329	52	434	508	38	587

(a) Including other packages.

By means of fortnightly cold storage holdings and the recorded imports of butter into the United Kingdom, it is possible to obtain a fairly reliable indication of the trend of consumption of imported butter. Owing to certain difficulties experienced at the Customs ports prior to and immediately succeeding the imposition of the duty on foreign butter on 1st March, 1932, and to a temporary increase in the lag between arrival of the steamer and entry of the goods, the Board's figures of weekly imports into the chief ports are not sufficiently accurate to be utilised for short-period movements of consumption last year; the same defects apply to a less extent in the case

of the official monthly imports. It has consequently been deemed desirable to portray the trend of consumption over longer periods, namely, every six months, when the error is likely to be of minor significance.

The apparent consumption of imported butter (including re-exports) was equal to just over 8,000 tons per week in 1932. Excluding re-exports, the apparent consumption averaged 7,700 tons per week, compared with 7,300 tons in 1931 and 6,400 tons in 1930, an increase of $5\frac{1}{2}$ per cent. and 20 per cent. respectively. This increase in the space of two years, equal to $3\frac{1}{2}$ lbs. per head per annum, is remarkable, and, although no figures are available, it is obvious that the growth has been partly at the expense of margarine.

Sufficient data have not yet been accumulated to measure seasonal changes in consumption. It is of interest to note that in each of the past three years the apparent consumption was greater in the second half of the year than in the first six months, but prices were then also on a lower level. Price considerations are probably a major factor in determining the trend of consumption.

Table II shows the apparent consumption of imported butter in the United Kingdom (including Northern Ireland) in six-monthly periods in the three years 1930, 1931 and 1932. To determine stocks at the beginning and end of each period, the average of stocks at the two nearest dates has been taken.

TABLE II.—*Apparent consumption of Butter in the United Kingdom*

	1930.		1931.		1932.	
	January to June.	July to December.	January to June.	July to December.	January to June.	July to December.
Gross Imports	3,609,345	3,212,275	3,986,252	4,073,816	4,170,854	4,278,272
Net Imports	3,547,462	3,100,957	3,795,490	3,913,129	3,913,729	4,227,774
Net Increase (+) or decrease (-) in stocks (a).	+454,629 (b)	-504,656	+270,954	-189,207	+201,461	-100,800
Apparent Consumption	3,092,833	3,605,613	3,524,536	4,102,336	3,712,268	4,328,574
Apparent Consumption per week.	118,956	138,677	135,560	157,782	142,780	166,484
	128,703		146,671		154,632	

(a) Corrected to allow for small quantities not covered by the Board's returns and including Northern Ireland.

(b) Excluding Northern Ireland.

THE CHEESE MARKET IN 1932

The production of cheese on farms in Great Britain* during the year ended 4th June, 1931, amounted to 689,800 cwts., compared with 647,500 cwts, in 1924-25. The production of cheese in factories employing more than ten persons amounted to 460,000 cwts. in 1930, according to the Board of Trade Census of Production, compared with approximately 112,000 cwts. in similar factories in 1924†. But there is reason to suppose that the bulk of this increase occurred in processed cheese, made mainly from bulk cheese, whether home or imported. The actual production of cheese in the calendar year 1931 seems to have been rather less than in other recent years. Indications are, however, that an increase occurred in 1932 and, particularly, that the output of autumn and winter cheese was rather above normal.

Imports of cheese into the United Kingdom during 1932, totalling 3,006,549 cwts., were 4 per cent. larger than in 1931 and practically equalled the average imports for the preceding four years.

Sources of Supply.—New Zealand maintained its post-war position as the principal source of imported cheese, supplying 62 per cent. of the 1932 total, with an increase of 7 per cent. over the previous year's figure, but below that for 1930. The post-war decline in imports of Canadian cheese was arrested in 1931, and a further increase of 6 per cent. occurred in the year under review, Canada supplying 25 per cent. of imports during each of the past two years. Larger quantities were received from Australia and South Africa. As a consequence, Empire supplies increased by 7 per cent. to comprise 90 per cent. of the total imports of cheese in 1932, as compared with 87 per cent. in 1931.

Imports from the Netherlands, the chief foreign source, slightly exceeded the previous year's reduced figure, but did not attain to the level of other recent years. Imports from Italy were reduced by 20 per cent., while there was a drastic decline in supplies from Switzerland. Aggregate imports from other foreign countries were smaller than in 1931, although certain small suppliers shipped larger quantities, notably Denmark, Finland, Norway and Russia. Supplies from the United States, at one time an important source, were reduced to negligible proportions. Imports from foreign countries as a whole were 13 per cent. less than in the previous year and the smallest since 1921.

* Cheese production is unimportant in Northern Ireland.

† Some 75,000 cwts. were manufactured in 1924 by firms employing less than ten persons.

Table I gives details of the imports of cheese into the United Kingdom in 1913 and from 1927 to 1932.

TABLE I.—Imports of Cheese into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000. cwts.	000. cwts.	000. cwts.	000. cwts.	000. cwts.	000. cwts.	000. cwts.
New Zealand	547	1,612	1,554	1,801	1,961	1,733	1,853
Canada	1,294	844	920	723	678	707	747
Australia.. .. .	8	36	74	50	48	68	74
Union of South Africa and South West Africa Territory.	—	1	—	—	16	15	17
Irish Free State.. ..	(a)	2	2	2	2	2	2
Netherlands	292	228	228	196	183	168	170
Italy	102	141	141	132	145	132	106
Switzerland	12	29	34	40	38	32	14
France	15	20	28	26	27	12	9
Denmark.. .. .	(b)	9	9	6	7	5	6
Finland	(b)	2	2	2	1	3	3
Belgium	2	4	2	4	1	2	1
Germany.. .. .	(b)	1	2	3	1	1	1
Norway	(b)	—	—	—	—	1	2
Russia	(b)	—	1	1	—	—	1
United States of America	22	17	5	7	4	4	—
Other Foreign Countries	3	3	3	1	—	1	1
Total Empire Countries	1,849	2,495	2,550	2,576	2,705	2,525	2,693
Total Foreign Countries	448	454	455	418	407	361	314
Total All Countries ..	2,297	2,949	3,005	2,994	3,112	2,886	3,007
<i>Re-exports</i>							
To Empire Countries..	32	25	23	23	20	21	} 29
To Foreign Countries..	33	14	7	9	10	8	
Total	65	39	30	32	30	29	29
Net Imports	2,232	2,910	2,975	2,962	3,082	2,857	2,978

(a) Not separately distinguished before April, 1923.

(b) Included in other Foreign Countries.

Exports and Re-exports.—Exports of home-produced cheese were practically negligible up to 1924. A considerable increase then occurred, reaching a peak of 57,000 cwts. in 1929, but since then the tendency has been downwards. Exports in 1932, at approximately, 36,000 cwts., were only slightly less than in 1931. These exports consisted largely of hard cheese sent to Germany, but the increased volume after 1924 is probably attributable in part to exports of processed cheese, which is manufactured largely from imported bulk types.

Exports of imported cheese have fluctuated at different times, but have moved within comparatively narrow limits in the past five years. Re-exports in 1932 totalled 29,000 cwts., or practically the same as in 1931.

Seasonal Variation.—Owing to the complementary nature of supplies from New Zealand and Canada there is no marked seasonal variation in total cheese imports.

The increase in imports in 1932 was slightly more marked in the second half of the year, but there was no definite trend in month-to-month variation compared with a year earlier. Imports were heaviest in March as a result of large arrivals from New Zealand, but these were followed by light supplies in April. Imports were at a minimum in October, when New Zealand supplies were seasonally small. In 1931, imports were greatest in February and smallest in June.

Table II shows the monthly imports of cheese into the United Kingdom in 1913 and in the seven years 1926 to 1932.

TABLE II.—*Monthly Imports of Cheese into the United Kingdom*

Month,	1913.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000	000	000	000	000	000	000	000
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January	137	348	278	224	345	338	233	243
February	147	170	201	272	316	201	281	234
March	150	238	296	319	228	266	274	304
April	136	231	183	193	242	273	243	204
May	156	217	220	281	238	226	279	239
June	175	232	275	240	219	207	146	240
July	281	388	237	223	233	267	238	285
August	242	303	290	329	270	289	205	248
September	265	205	269	193	194	234	196	281
October	227	237	222	246	234	220	278	201
November	241	239	278	293	251	246	256	249
December	140	206	200	192	224	345	257	279
Total	2,297	3,014	2,949	3,005	2,994	3,112	2,886	3,007

Table III shows the monthly imports of cheese from the principal sources of supply in 1932.

TABLE III.—*Monthly Imports of Cheese from Chief Countries of Consignment in 1932*

Month.	New Zealand.	Australia.	Canada.	Italy and Netherlands.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	198	10	8	24	3	243
February ..	173	13	4	37	7	234
March ..	271	5	8	17	3	304
April ..	167	10	1	22	4	204
May ..	192	—	11	30	6	239
June ..	159	3	48	25	5	240
July ..	148	1	110	21	5	285
August ..	84	2	136	20	6	248
September..	120	1	133	21	6	281
October ..	47	3	126	20	5	201
November	109	8	110	20	2	249
December ..	185	18	52	19	5	279
Total ..	1,853	74	747	276	57	3,007

PRICES

According to commercial estimates, stocks of cheese throughout 1932 were appreciably lighter than a year earlier. The year 1932 opened with imported cheese prices rather lower than in 1931. From the end of January, however, an upward tendency developed for New Zealand cheese and from then until early in June prices were above the previous year's level. In the first half of 1932 New Zealand finest white averaged over 9 per cent. higher than a year earlier. From the seasonal low point in June prices gradually rose, but, except in September, were lower than a year previously. Prices dropped rapidly throughout December, until, at the end of the year, quotations were the lowest since May, 1931. For the year as a whole, however, New Zealand finest white averaged about 3 per cent. higher than in 1931. Between 1931 and 1930 a decline of 24 per cent. had occurred. New Zealand coloured cheese was relatively scarce in the first half of

1932 and values were higher than for white. From August to the beginning of December, however, white was in relatively short supply and a price margin, at times considerable, existed in its favour. For the whole year finest coloured averaged about one shilling less than white and was also slightly below the 1931 average.

TABLE IV.—*Cheese Prices at London*

Month.	New Zealand Finest White.		Canadian Finest White.		New Zealand Finest Coloured.		Canadian Finest Coloured.	
	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.
	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.
January ..	58 6	58 0	70 0	77 6	57 0	57 6	70 0	75 6
February ..	62 3	56 9	71 0	77 6	63 3	57 6	70 6	77 6
March ..	61 3	55 9	72 6	76 6	62 3	58 0	72 0	77 6
April ..	61 6	51 0	72 0	75 0	62 6	54 6	71 6	76 6
May ..	57 9	50 6	72 0	74 0	58 0	53 3	71 6	74 6
June ..	56 3	54 9	75 6	74 0	56 6	57 6	71 6	74 0
July ..	58 9	60 0	{84 0*	72 9*	57 9	62 6	{72 0*	73 6*
			{58 6†	61 0†			{58 3†	62 6†
August ..	60 9	62 6	61 0	{71 6*	57 3	64 0	61 0	{71 6*
				62 9†				64 0†
September ..	64 6	62 0	66 6	63 0	60 3	63 6	66 3	63 9
October ..	66 0	69 0	68 9	70 0	60 3	69 6	68 3	70 0
November ..	63 3	67 3	69 0	70 0	60 0	66 0	69 3	71 0
December ..	56 0	61 3	68 3	70 0	58 9	59 3	68 3	69 6
Average for Year.	60 6	59 0	69 0†	71 0†	59 6	60 3	68 3†	71 3†

* Old.

† New.

‡ The yearly average for Canadian is calculated on prices of "old" cheese for the period January to June, and on "new" cheese from July to December.

Canadian cheese at the beginning of the year was 8s. below the previous year's level, but a steady trade for the short stocks brought prices gradually to a par with 1931 by the end of May. New season's produce was on the market fully three weeks earlier than in the previous

year and quotations remained under those of 1931, and on an approximately similar level to New Zealand cheese until September. In the last quarter of the year prices quoted ruled slightly below the 1931 level. Average prices for both white and coloured in 1932 were 2 to 3 per cent. less than in 1931, with white cheese averaging slightly more than coloured.

The price margin in favour of Canadian cheese over New Zealand was less marked in 1932 than in 1931.

The average prices of both New Zealand and Canadian cheese during 1932 were from 33 to 34 per cent. lower than in 1929; that is, the decline has been less pronounced than in the case of butter.

Table IV gives average monthly prices for New Zealand and Canadian finest white and coloured cheese at London in 1932, as compared with 1931. The figures are taken from the weekly quotations of the London Provision Exchange and represent the average of top prices of a series.

Following the depreciation of sterling in September, 1931, quotations for Dutch cheese increased and exceeded the corresponding 1930 figures until the end of the year. Prices during 1932 remained in excess of the previous year's level except for a period during the summer. For the year as a whole full cream Gouda and 40 per cent. Edam, the principal Dutch types imported apart from those listed under "other kinds" in the Netherlands Trade Returns, averaged 6 to 7 per cent. higher than in 1931, following a price decline of 10 to 11 per cent. between 1930 and 1931.

Average top prices of these descriptions in 1931 and 1932, as quoted on the London Provision Exchange, are given in Table V on page 38.

Home Produced Cheese.—Prices for home-produced cheese in 1932 compared favourably with those of 1931 until towards the end of the year. The latest details of the production of cheese on farms in Great Britain refer to the year 1930-31 (*see* page 32). No figures are available of the quantity manufactured in 1932. Cheddar cheese prices had declined in 1931, but had shown a more than normal seasonal increase towards the end of that year. Quotations for finest farmer's cheese at London and Bristol at the beginning of 1932 ruled above those of a year earlier, the difference becoming more marked as supplies became short. New season's produce also obtained a slight premium over 1931, which was maintained until December.

Nominal quotations for Scotch Cheddar at Glasgow in the first half of 1932 ruled appreciably under the 1931 level, but with the commencement of the new season prices exceeded those of a year earlier and remained on a higher scale until near the end of the year.

TABLE V.—Average Price of Certain Dutch Cheese at London

Month.	Edam. Factory 40 per cent.		Gouda. Full Cream.	
	1932.	1931.	1932.	1931.
	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.
January	71 6	67 9	80 6	72 6
February	81 9	69 3	86 6	76 0
March	76 6	70 6	83 6	77 0
April	59 6	61 6	68 0	68 9
May	52 0	55 3	59 0	63 0
June	61 3	53 6	69 6	61 6
July	60 6	64 6	69 0	69 3
August	62 6	59 0	70 6	67 0
September	64 6	57 9	75 3	66 6
October	72 6	68 3	85 0	81 0
November	76 6	67 0	94 0	78 3
December	76 6	70 0	90 6	79 6
Average for year ..	68 0	63 9	77 6	71 9

In the case of Cheshire cheese, light supplies following a temporary shortage of milk had brought prices at the end of 1931 to a high level, which continued into 1932. When the new season's make came on the market, however, prices were generally on a par with, and occasionally slightly below, the 1931 level. Prices fell away in November and December and the discrepancy compared with a year previously exceeded 50s. per cwt. at the end of 1932. During the whole year, supplies at the three chief fairs (Chester, Whitchurch and Nantwich) were practically the same as in 1931, but prices, on the average, were very slightly higher.

Supplies of Caerphilly cheese at Highbridge in 1932 totalled 1,046 tons, as compared with 1,365 tons in the previous year, while the average price increased from 75s. 4d. in 1931 to 83s. 4d. in 1932.

IMPORTS OF CONDENSED MILK AND MILK POWDER

Imports of condensed milk have grown appreciably in recent years, but a slight decline occurred in 1932, when the aggregate quantity imported was about 2 per cent. less than in 1931. Imports of *sweetened skimmed condensed milk*, which comprised 78 per cent. of the total by weight in 1932, continued the increase which has been a feature of post-war years, but there was a substantial decline in imports of *sweetened whole* and *unsweetened condensed milk*.

Imports of milk powder, the bulk of which is unsweetened, showed a rapid expansion up to 1931, but gross imports in 1932 were 9 per cent. smaller than in that year, although larger than in any previous year.

The factory output of condensed milk in Great Britain in 1930, excluding production in a number of small factories from which returns were not received, amounted to 874,000 cwts., an increase of 14 per cent. over the comparable 1924 figure. Details of the manufacture of the different classes are not yet available for 1930, but in 1924 it was estimated that about two-thirds consisted of sweetened whole condensed milk, one-eighth of sweetened skimmed and about one-fifth of unsweetened condensed milk. Exports of home-produced condensed milk in 1930 were equal to nearly one-quarter of the total production; excluding these, home production accounted for about one-fifth of the total quantity available for consumption.

The production of milk powder, sweetened and unsweetened, by factories in Great Britain in 1930 was estimated at 134,000 cwts., an increase of 13 per cent over the comparable 1924 figure. Home production in 1930 accounted for about one-third of the total quantity available for consumption.

An export trade exists for condensed milk manufactured in the United Kingdom, principally to tropical countries, but shipments have fallen off markedly in recent years. Total exports of sweetened condensed milk from the United Kingdom amounted to 57,626 cwts. in 1932, as compared with 81,183 cwts. in 1931 and 152,963 cwts. in 1930. Exports of unsweetened condensed milk amounted to 26,750 cwts. in 1932, as against 36,790 cwts. and 45,288 cwts. in 1931 and 1930 respectively.

Table I summarises the imports of the different types of preserved milk in 1913 and the seven years 1926 to 1932.

TABLE I.—Imports of Condensed Milk and Milk Powder into the United Kingdom

Year.	Sweetened Whole.	Sweetened Skimmed.	Un-sweetened Whole.	Milk Powder.		Preserved Milk, Other Kinds (Un-sweetened).
				Unsweetened.	Sweetened.	
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
1913..	481,435	720,772	50,008	46,572	7	15,870
1926..	257,133	1,773,431	361,758	135,168	1	29,399
1927..	253,272	1,854,759	411,485	137,794	32	26,709
1928..	297,015	1,951,025	425,406	199,706	63	34,073
1929..	258,421	1,986,893	405,387	263,048(a)	16,475(a)	4,912(a)
1930..	226,666	1,972,432	402,967	250,440(a)	14,364(a)	2,360(a)
1931..	229,646	2,085,535	483,579	352,652(a)	8,106(a)	5,100(a)
1932..	205,547	2,139,007	394,823	320,283(a)	6,216(a)	6,231(a)

(a) As a result of changes in methods of classification the figures for milk powder and preserved milk, other kinds, for 1929 onwards are not strictly comparable with those for previous years.

TABLE II.—Imports of Sweetened Whole Condensed Milk into the United Kingdom

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Canada	13,951	12,142	9,930	7,971	5,147	27,625
Irish Free State	238	1,855	2,408	5,599	5,860	5,920
New Zealand	—	1,853	8,115	9,046	83	2,213
Other Empire Countries	—	138	14	364	97	52
Netherlands.. .. .	155,807	171,514	161,829	147,967	146,772	140,993
Denmark	31,996	29,098	30,087	28,583	27,079	24,706
Switzerland	49,238	77,736	43,492	25,601	41,754	2,497
Belgium	874	1,941	1,210	1,108	2,532	1,250
Other Foreign Countries	1,168	738	1,336	427	322	291
Total Empire Countries	14,189	15,988	20,467	22,980	11,187	35,810
Total Foreign Countries	239,083	281,027	237,954	203,686	218,459	169,737
Total All Countries.. .. .	253,272	297,015	258,421	226,666	229,646	205,547

Imports of *sweetened whole condensed milk* have tended to decline in recent years to well below the average in the immediate pre-war years; the quantity imported in 1932 was 10 per cent. smaller than in 1931. Slightly smaller quantities were received from the Netherlands, the principal source, which accounted, however, for 69 per cent. of total imports, as against 64 per cent. in 1931. Imports from Denmark also continued the gradual downward trend of the past few years, but the reduction in total receipts was due chiefly to a marked falling off in supplies from Switzerland. Empire supplies were augmented by a five-fold increase in imports from Canada and, with a further small increase in Irish Free State supplies and a slight recovery in arrivals from New Zealand, comprised 17 per cent. of total imports of this description, as compared with 5 per cent. in 1931.

Table II gives details of the gross imports of *sweetened whole condensed milk* in each of the six years 1927 to 1932. Re-exports are practically negligible.

The rapid rate of expansion of imports of *sweetened skimmed condensed milk* has fallen off in the past few years, but the upward tendency has continued and imports in 1932 were the largest ever

TABLE III.—*Imports of Sweetened Skimmed Condensed Milk into the United Kingdom*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
Irish Free State ..	53,488	82,724	71,204	70,517	38,622	50,003
Other Empire Countries.	1,025	396	172	149	205	243
Netherlands ..	1,445,649	1,569,553	1,602,131	1,628,797	1,827,907	1,851,320
Denmark	343,615	292,738	307,202	261,432	205,508	227,783
Italy	7,620	3,783	2,322	10,059	12,187	6,709
Other Foreign Countries.	3,362	1,831	3,862	1,478	1,106	2,949
Total Empire Countries.	54,513	83,120	71,376	70,666	38,827	50,246
Total Foreign Countries.	1,800,246	1,867,905	1,915,517	1,901,766	2,046,708	2,088,761
Total All Countries	1,854,759	1,951,025	1,986,893	1,972,432	2,085,535	2,139,007

recorded, being nearly 3 per cent. greater than in 1931 and three times as heavy as in 1913. The Netherlands, which accounted for 87 per cent. of the total, shipped slightly larger quantities than in the previous year and imports from Denmark increased by 18 per cent. Imports from the Irish Free State were 30 per cent. larger than a year earlier, but Empire supplies comprised only 2 per cent. of the total imports of this type, or the same proportion as in 1931.

Imports of *sweetened skimmed condensed milk* in the six years 1927 to 1932 are given in Table III. Re-exports are insignificant.

Imports of *unsweetened condensed milk*, consisting entirely of condensed whole milk in 1932, were 18 per cent. smaller than in 1931 and the smallest since 1926. The Netherlands was the chief source, but accounted for 22 per cent. less than in the previous year, while imports from the United States were reduced to little more than one-third of the 1931 figure. Imports from Denmark and Germany

TABLE IV.—*Imports of Unsweetened Condensed Milk into the United Kingdom*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Canada	73,756	42,928	15,218	13,709	24,489	66,345
Irish Free State	614	570	3,535	5,067	10,069	22,587
Other Empire Countries ..	—	4	1	4	45	1,415
Netherlands	64,895	94,177	158,314	151,649	154,875	118,835
Belgium	12,466	17,034	24,087	58,012	71,340	57,149
Denmark	9,823	13,588	29,931	37,692	43,128	55,890
Germany	473	1,309	13,578	27,070	8,646	12,895
Switzerland	4,287	2,235	1,960	1,929	4,674	1,143
United States of America	244,326	249,170	158,230	107,127	165,306	58,250
Other Foreign Countries ..	845	4,391	533	708	1,007	314
Total Empire Countries ..	74,370	43,502	18,754	18,780	34,603	90,347
Total Foreign Countries ..	337,115	381,904	386,633	384,187	448,976	304,476
Total All Countries ..	411,485	425,406	405,387	402,967	483,579	394,823
<i>Re-exports</i>	<i>4,430</i>	<i>3,384</i>	<i>4,515</i>	<i>3,976</i>	<i>6,990</i>	<i>2,719</i>
Net Imports	407,055	422,022	400,872	398,991	476,589	392,104

were increased, but smaller quantities were recorded from other foreign sources. There was a large increase in imports from Canada and the Irish Free State and, with the appearance of moderate quantities from New Zealand, Empire supplies as a whole accounted for 23 per cent. of total imports, a greater proportion than in other recent years and compared with 7 per cent. in 1931.

There is a small re-export trade in *unsweetened condensed milk*, but the total of 2,700 cwts. shipped in 1932 was smaller than in previous years. Table IV gives details of the gross and net imports in the six years, 1927 to 1932.

TABLE V.—Imports of Milk Powder (a) (Unsweetened) into the United Kingdom

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
New Zealand	56,901	80,902	99,650	87,415	102,424	105,667
Australia	100	1,390	12,433	5,696	6,800	32,520
Canada	20,783	29,271	34,412	25,988	42,025	28,598
Irish Free State	1,851	1,790	2,208	1,888	807	838
British India	—	—	—	—	—	501
Netherlands	49,166	69,224	90,485	96,911	100,169	125,504
France	2,429	11,273	8,735	8,127	7,369	5,701
Switzerland	1,950	872	5,715	7,740	4,596	1,969
Denmark	1,045	3,158	4,503	3,506	3,119	1,606
Belgium	(b)	708	1,894	1,607	753	1,380
Italy.. .. .	(b)	—	2	1	1,696	—
Germany	(b)	169	783	294	841	906
Chile	(b)	—	—	—	—	1,089
United States of America	2,667	939	2,188	10,967	82,038	13,686
Other Foreign Countries..	902	10	40	300	15	318
Total Empire Countries ..	79,635	113,353	148,703	120,987	152,056	168,124
Total Foreign Countries ..	58,159	86,353	114,345	129,453	200,596	152,159
Total All Countries ..	137,794	199,706	263,048	250,440	352,652	320,283
Re-exports	6,025	20,139	17,389	17,331	13,505	10,800
Net Imports	131,769	179,567	245,659	233,109	339,147	309,483

(a) Owing to changes in methods of classification the figures from 1929 onwards are not strictly comparable with those for earlier years.

(b) Included in Other Foreign Countries.

The decline in imports of *milk powder (unsweetened)* in 1932 was due in great measure to the drastic decrease in imports from the United States, which had shown a sudden expansion in 1931. The Netherlands, with an increase of 25 per cent., displaced New Zealand as the principal source, although the latter country sent 3 per cent. more than in 1931. Imports from Canada showed a substantial decrease, following a large increase in the previous year, but much larger quantities than in other recent years were imported from Australia. The small imports from other countries were on a reduced scale.

Empire supplies as a whole accounted for 53 per cent. of total imports in 1932, compared with 43 per cent. in 1931.

Exports of imported *milk powder (unsweetened)* have fallen off since 1928 and the total of 10,800 cwts. in 1932 was 2,705 cwts. less than in 1931.

Table V shows the gross and net imports of *milk powder (unsweetened)* in the six years 1927 to 1932.

Seasonal Variation.—Seasonal variations in supplies of imported condensed milk are now relatively unimportant, but Continental milk production is at a maximum in spring and summer, and imports of sweetened skimmed condensed milk, a by-product of the butter industry, tend to be greater during that period. Details of the imports month by month indicate that the decline in 1932 compared with a year earlier occurred largely in the last quarter of the year, when supplies of sweetened skimmed were appreciably under the previous year's level, although imports of sweetened whole were then on a heavier scale than in 1931. December was the first complete month in which the new duties imposed under the Ottawa Agreements Act operated, and all imports were then substantially under the previous year's figures.

The decline in imports of milk powder occurred in the first half of the year, imports in the second six months being greater than a year previously as a result of increased shipments from New Zealand.

Table VI shows the monthly imports of the principal classes of condensed milk and milk powder in 1931 and 1932.

TABLE VI.—*Monthly Imports of Condensed Milk and Milk Powder into the United Kingdom during 1931 and 1932*

Month.	Sweetened, whole.		Sweetened, skimmed.		Unsweetened.		Milk Powder (unsweetened).	
	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.
	000	000	000	000	000	000	000	000
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	16.0	14.8	143.4	153.5	24.8	37.0	21.7	19.9
February ..	18.0	14.2	171.7	140.6	56.7	30.4	23.8	29.2
March ..	14.4	18.3	179.9	203.6	32.5	29.4	43.7	33.2
April ..	14.0	19.5	211.1	193.5	15.1	43.2	21.1	56.0
May ..	13.3	18.7	216.7	180.5	25.6	37.7	23.9	37.8
June..	12.8	27.3	209.9	194.1	30.1	37.0	19.8	26.0
July ..	13.2	23.4	170.3	170.2	30.0	49.9	16.6	19.8
August ..	21.0	19.7	173.9	173.6	25.1	48.7	24.4	16.7
September ..	25.1	26.2	183.6	173.6	63.1	41.4	37.6	21.8
October ..	29.7	17.4	167.1	171.6	39.1	45.9	21.9	28.5
November ..	17.9	15.5	164.3	171.3	37.7	45.9	38.3	32.2
December ..	10.1	14.6	147.1	159.4	15.0	37.1	27.5	31.6
Total ..	205.5	229.6	2,139.0	2,085.5	394.8	483.6	320.3	352.7

THE EGG MARKET IN 1932

Imports of eggs into the United Kingdom have expanded in recent years, apart from slight reductions in 1929 and 1931. The total quantity of 19,977,467 great hundreds imported in 1932, however, was no less than 6 million great hundreds, or 23 per cent., less than in 1931 and the lowest since 1922. If supplies from the Irish Free State be excluded, no comparable figures being available, imports were well below the pre-war level.

Home production of eggs in recent years has comprised an increasing proportion of total consumption. According to the Agricultural Census of Production the total number of eggs produced in the United Kingdom in 1930-31, excluding eggs for hatching but including an estimate of production on allotments, private gardens, etc., amounted

to 34 million great hundreds. Applying the methods adopted at the census to the calendar years 1931 and 1932, home production is estimated to have increased in these years to 35.4 million great hundreds and 38 million great hundreds respectively, and the quantity produced in Great Britain and Northern Ireland accounted for 65 per cent. of the total number consumed in 1932, a much higher proportion than in other recent years and compared with 58 per cent. in 1931. But the decreased imports more than offset the heavier home production, and the *per capita* consumption of eggs in the United Kingdom declined from 160 in 1931 to 150 in 1932.*

The output of eggs packed under the National Mark in England and Wales in 1932 is estimated at 312 millions (2.6 million great hundreds) as compared with 234 millions in 1931, an increase of 34 per cent.

Sources of Supply.—Two significant changes, in respect of the source of imported supplies, characterised the egg market in 1932. These may be summarised as follows:—(1) A marked decline in imports from European countries, the reduction in the aggregate amounting to 29 per cent. The primary cause was undoubtedly the relatively low prices on the United Kingdom market in terms of the currencies of exporting countries, following the departure from the gold standard and later accentuated by increased tariff rates. As a result, Germany became a more profitable market for Near-European countries, particularly as German production had declined and as exports from Central and Southern Europe to Germany were substantially reduced (*see also* page 116). (2) The considerable increase in imports from Australia which in the space of a few years has brought that country among the major sources of imported eggs, occupying fifth position in 1932.

Denmark retained its position as principal source of imported eggs into the United Kingdom in 1932, although sending 15 per cent. less than in 1931, the decrease occurring in the second half of the year. Following a decline of 4 per cent. in 1931, imports from the Irish Free State, the second largest source, were reduced by 14 per cent. Of the other principal supplying countries, imports from the Netherlands were reduced to little more than one-third of the previous year's level, and that country dropped from third to

* This consumption figure for 1931 differs from that published in "Dairy Produce Supplies in 1931," owing chiefly to an increase in the estimated annual yield per hen to 120, as revealed in the 1930-31 census, compared with 100 in the 1924-25 census.

TABLE I.—Imports of Eggs (in shell) into the United Kingdom

Countries whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.
Irish Free State	(a)	5,051	5,177	5,015	4,781	4,575	3,932
Australia	(b)	122	267	375	555	918	1,515
Union of South Africa (f)	(b)	372	339	394	467	589	528
Canada	2	42	83	79	15	47	5
New Zealand	(b)	6	14	22	11	12	16
Other Empire Countries	2	—	—	1	7	—	2
Denmark	4,265	5,680	5,330	5,573	6,728	7,549	6,393
Poland	(d)	3,388	2,562	2,385	3,613	2,687	1,874
Belgium	73	2,141	2,908	2,962	2,334	2,073	1,584
Netherlands	977	2,360	2,725	3,169	3,631	3,839	1,400
Sweden	385	548	539	619	491	339	361
Finland	(e)	5	2	3	12	59	311
Germany	514	241	334	267	391	508	232
Norway	(c)	8	11	111	105	110	188
Russia	11,453	1,586	1,767	608	85	262	87
Lithuania	(e)	11	56	29	32	75	68
France	702	429	1,659	868	659	97	19
Estonia	(e)	57	69	12	3	12	12
Latvia	(e)	639	546	131	42	39	10
Italy	846	87	58	31	65	26	1
Austria	} 884	9	—	—	—	1	—
Hungary		6	2	2	—	4	3
Roumania		7	—	3	1	—	—
China	3	681	945	1,624	1,713	1,497	853
Egypt	1,097	669	810	572	451	221	247
Morocco	114	1	—	—	—	—	—
Uruguay	(c)	13	62	17	15	73	204
Argentina	(c)	81	99	60	77	205	101
Chile	(c)	—	—	4	—	—	14
United States of America	6	93	92	18	192	96	—
Other Foreign Countries	31	7	10	10	15	12	17
Total Empire Countries ..	4	5,593	5,880	5,886	5,836	6,141	5,998
Total Foreign Countries ..	21,576	18,747	20,586	19,078	20,705	19,784	13,979
Total All Countries ..	21,580	24,340	26,466	24,964	26,541	25,925	19,977
Re-exports	181	39	92	221	111	52	61
Net Imports	21,399	24,301	26,374	24,743	26,430	25,873	19,916

- (a) Not separately distinguished before 1st April, 1923. (d) Included in Russia, Germany and Austria-Hungary.
 (b) Included in Other Empire Countries. (e) Included in Russia.
 (c) Included in Other Foreign Countries. (f) Including South West Africa Territory.

sixth place among the list of supplying countries; supplies from Poland and Belgium declined by 30 per cent. and 24 per cent. respectively, and there was a substantial decrease in the quantity entered from Germany, much of which was probably of Polish origin. Among other European countries, only Sweden, Norway and Finland shipped larger quantities, the increase in the case of the last-named country being over five-fold, compared with 1931, which itself witnessed a considerable expansion over shipments in earlier years. Imports from China were reduced by 43 per cent., but larger quantities were received from Egypt. There was almost an entire absence of eggs from the United States and imports from Argentina were reduced by more than half, but supplies from Uruguay were nearly three times as heavy as in 1931.

The substantial increase in Australian entries was offset by reduced supplies from the Irish Free State, South Africa and Canada and Empire supplies as a whole declined by 2 per cent., but accounted for 30 per cent. of total imports, the largest proportion ever recorded, compared with 24 per cent. in 1931 and 22 per cent. in 1930.

Details of the imports of eggs during 1913, and the six years, 1927 to 1932, are shown in Table I.

In addition to the imports shown in this table there is a substantial trade in eggs imported into Great Britain from Northern Ireland although no separate returns are available. Exports of eggs through Northern Ireland ports increased up to 1931, when they exceeded $3\frac{1}{4}$ million great hundreds, but fell off slightly to 3,067,000 great hundreds in 1932. It is not known what proportion of these, if any, was of Irish Free State origin.

There is a small and fluctuating re-export trade in eggs from the United Kingdom, which have been taken principally by Argentina and Germany. These re-exports in 1932, at 61,000 great hundreds, were slightly above the reduced 1931 figures.

Seasonal Variation.—Imports of eggs tend to be greatest in the spring months, corresponding with the period of maximum European production. Throughout 1932 imports were on a smaller scale than in 1931. Following a low rate of importation in the first three months the quantity registered in April rose well above the level of other months, chiefly as a result of large entries from Denmark, but did not attain to the previous year's corresponding figure. In the first six months of the year imports were 22 per cent. less than in the

same period of 1931, European countries other than Denmark shipping smaller quantities. In the second half the reduction amounted to 24 per cent., Danish supplies being then also on a smaller scale; in the month of December, imports were only two-thirds of the 1931 figure. Imports were heaviest in April and lightest in December, whereas in 1931 May was the month of maximum and February of minimum supply. As a result also of the considerable disparity between April and December arrivals, imports showed a relatively greater seasonal variation than in other recent years.

Table II shows the monthly imports of eggs in the seven years 1926 to 1932.

TABLE II.—*Monthly Imports of Eggs into the United Kingdom*

Month.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.
January	1,494	1,543	1,739	2,223	2,366	2,079	1,373
February	1,312	1,351	1,863	1,139	1,989	1,708	1,486
March	2,141	2,112	2,252	1,599	2,216	2,028	1,472
April	2,360	2,498	2,323	2,367	2,288	2,231	2,094
May	1,911	2,240	2,668	2,480	2,518	2,426	1,791
June	2,033	2,618	2,874	1,776	2,275	2,350	1,748
July	1,953	2,046	2,156	2,229	2,219	2,323	1,776
August	1,732	1,749	2,199	2,276	2,186	2,194	1,755
September	1,806	1,984	1,744	1,932	1,927	2,126	1,612
October	1,936	2,464	2,206	2,285	2,376	2,165	1,751
November	1,671	1,939	2,424	2,354	1,936	2,264	1,784
December	1,776	1,796	2,018	2,304	2,245	2,031	1,335
Total	22,125	24,340	26,466	24,964	26,541	25,925	19,977

Table III shows the monthly imports in 1932 from the principal sources of supply. It brings out the considerable drop in European supplies towards the end of the year and the important part played by Southern Hemisphere eggs in that period. The groupings adopted are largely arbitrary, but to some extent they are in accordance with similarities in the class of egg.

TABLE III.—*Monthly Imports of Eggs into the United Kingdom during 1932*

Month.	Irish Free State.	Denmark.	Netherlands, Belgium and France.	Australia, New Zealand and South Africa.	Poland, Egypt and China.	Other Countries.	Total.
	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.
January ..	140	398	263	205	276	91	1,373
February ..	276	511	383	2	188	126	1,486
March ..	612	581	200	2	32	45	1,472
April ..	713	822	393	—	91	75	2,094
May ..	701	599	282	—	100	109	1,791
June ..	497	555	305	—	186	205	1,748
July ..	337	642	350	—	239	208	1,776
August ..	254	631	347	10	372	141	1,755
September ..	174	567	201	124	406	140	1,612
October ..	119	506	137	411	412	166	1,751
November ..	73	342	104	758	330	177	1,784
December ..	36	239	38	546	342	134	1,335
Total ..	3,932	6,393	3,003	2,058	2,974	1,617	19,977

Cold Stored and Preserved Eggs

The United Kingdom Trade Returns do not differentiate between fresh and preserved eggs, the latter term relating to eggs which have been preserved in spring, in cold storage or by some method of pickling, for sale in the period of scarcity. The proportion of home-produced eggs preserved by consumers in the United Kingdom is probably considerable. No particulars are available of the quantity of home-produced eggs which are preserved commercially, but the proportion to total supplies would appear to be small and, at any rate, not over 5 per cent. On the other hand, a large proportion of the imports in the winter months consists of preserved eggs. Few countries make the differentiation in their official trade statistics, but among those which do are some of the principal countries of supply of preserved eggs. Table IV shows the exports of fresh and preserved eggs (including cold-stored) to the United

Kingdom from the Netherlands, Denmark and the Irish Free State during the four months October, 1932, to January, 1933, the period when practically all the preserved eggs are imported; aggregate figures for the corresponding period a year earlier are also given. Figures for the Irish Free State relate to exports to all destinations, but the United Kingdom takes the bulk of the shipments.

TABLE IV.—*Exports of Fresh, Cold-stored and Preserved Eggs to the United Kingdom from certain Countries*

	October, 1932.	November, 1932.	December, 1932.	January, 1933.	Total, 4 months.	<i>Corres- ponding Period, 1931-1932.</i>
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
<i>Netherlands.</i>						
Fresh	5.9	1.1	1.2	3.8	12.0	34.9
Cold-Stored ..	4.8	8.5	1.1	—	14.4	49.5
Preserved ..	0.3	0.4	0.1	—	0.8	12.1
Total ..	11.0	10.0	2.4	3.8	27.2	96.5
	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.
<i>Denmark.</i>						
Fresh	242.6	93.5	190.6	262.3	789.0	1,032.6
Cold-Stored ..	234.3	198.1	77.9	2.6	512.9	1,016.9
Preserved .. }						
Total ..	476.9	291.6	268.5	264.9	1,301.9	2,049.5
<i>Irish Free State (a)</i>						
Fresh	107.6	40.5	20.1	141.7	309.9	421.9
Cold-Stored ..	8.0	26.7	14.5	0.4	49.6	82.8
Preserved .. }						
Total ..	115.6	67.2	34.6	142.1	359.5	504.7

(a) Total exports.

During the foregoing period imported eggs generally were in much lighter supply than a year previously, but it will be seen from the table that the reduction, at least for these countries, was greater in the case of preserved eggs than in fresh. Thus, in the 1932-33

season, exports of preserved and cold-stored eggs from the Netherlands to the United Kingdom comprised 56 per cent. of total egg exports to the United Kingdom from that source, and from Denmark under 40 per cent., compared with 64 per cent. and 56 per cent. respectively in the corresponding four months a year earlier. Exports of preserved and cold-stored eggs from the Irish Free State during this period accounted for 14 per cent. of total egg exports, compared with 16 per cent. in the 1931-32 season.

With low prices and the uncertainty of the volume of United Kingdom and Southern Hemisphere eggs to be marketed during the winter months, it is not unlikely that some reduction in preserving for the market may have taken place in the spring of 1932. On the other hand, the reduction in imports of preserved eggs compared with a year earlier occurred chiefly towards the end of the season, in December, 1932, and January, 1933. In this connection it is worthy of note that the *ad valorem* duty on foreign eggs was replaced by a range of specific duties towards the end of November, 1932, under the terms of the Ottawa Agreements Act. These duties would bear relatively more heavily upon the cheaper preserved eggs and it is reasonable to assume that this was a significant factor in causing a reduction of supplies.

In addition to the foregoing countries, preserved eggs are also imported from other countries, chiefly Poland, Belgium and China; the small quantities of eggs imported from Canada are mainly cold-stored.

PRICES

Between 1929 and 1932 egg prices declined by approximately 40 per cent., a reduction similar in extent to that for butter.

In 1932 prices, for both home and imported eggs, declined seasonally from January until the low point was reached in the last week of March, or a fortnight earlier than in 1931. In these three months prices were, on the average, about 12 per cent. below the previous year's level. In the following months the tendency was upwards, the prices for imported eggs corresponding closely to those of the previous year, but National Mark eggs did not attain the 1931 level until the end of August. Prices declined in September, but increased rapidly to a peak at the beginning of November, or the same week as in the previous year. At this point home eggs were two to three shillings lower in price than a year earlier and imported eggs higher. A sharp decline in November was followed by a steadier

tendency in December. In the second half of 1933 National Mark eggs were dearer than a year earlier in September, part of October and in December, but imported eggs tended to exceed the previous year's level during most of this period.

For the year as a whole National Mark Specials were lower than in 1931 by 6 per cent., while Danish 18 lb. declined by only 2 per cent. This tendency was apparent in other descriptions, the increased quantities of home eggs experiencing a relatively greater decline than the reduced supplies of imported. In each of the two preceding years the price decline was in the region of 12 to 15 per cent. (Prices for Southern Hemisphere eggs are discussed on page 99, *et seq.*)

Table V gives average monthly prices (unweighted) of National Mark Specials in 1931 and 1932, with corresponding figures for approximately comparable imported descriptions, namely, Danish 18 lb. and Dutch 18 lb. The prices are from the weekly quotations of the London Egg Exchange. Quotations for National Mark Specials and Danish 18 lb. from 1929 to 1932 are shown graphically in fig. 4.

TABLE V.—Average Prices of Eggs at London

Month.	English N.M. Specials.		Danish 18 lb.		Dutch 18 lb.	
	1932.	1931.	1932.	1931.	1932.	1931.
	Per 120.	Per 120.	Per 120.	Per 120.	Per 120.	Per 120.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
January	18 9	22 2	16 7	17 6	17 1	17 6
February	14 8	17 6	12 7	15 6	13 8	15 6
March	11 5	13 4	10 7	12 7	12 2	12 11
April	11 1	11 6	9 4	9 11	10 1	10 7
May	10 9	12 2	9 6	9 11	10 6	10 11
June	12 7	13 0	10 10	10 11	11 11	11 4
July	14 3	16 11	11 8	11 5	11 11	12 3
August	15 8	17 0	12 7	12 6	13 5	12 11
September	18 11	18 9	14 9	13 3	16 1	15 0
October	21 11	22 2	16 8	16 6	19 0	17 2
November	24 1	26 5	22 0	20 4	25 4	22 10
December	21 10	20 3	18 11	19 0	—	21 2
Average	16 4	17 5	13 10	14 1	14 8*	15 0

* Eleven months.

FIG. 4. PRICES OF ENGLISH NATIONAL MARK AND DANISH EGGS AT LONDON, 1929-1932

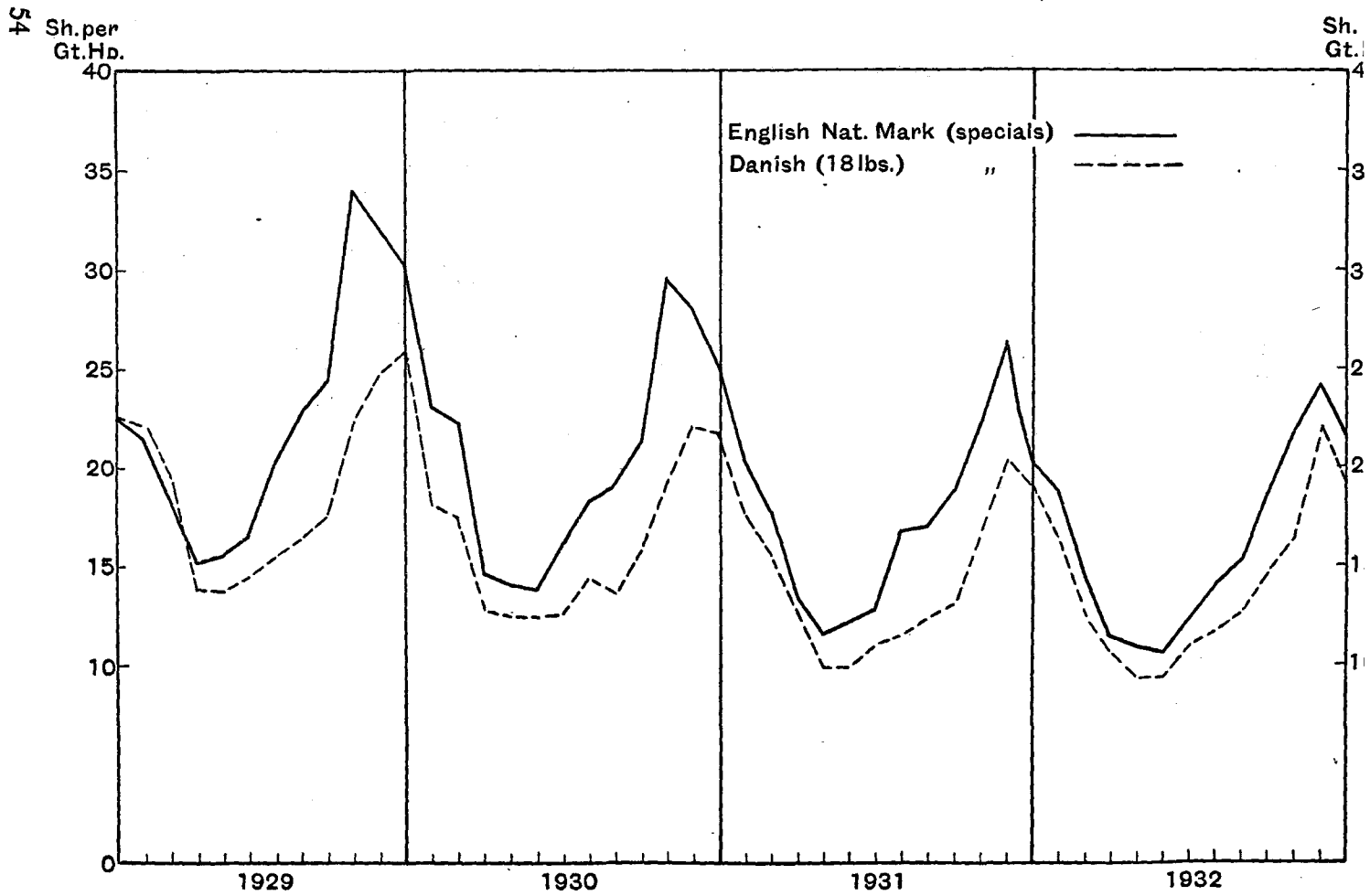


Table VI shows monthly average prices for certain other descriptions of eggs at London, also taken from the weekly quotations of the London Egg Exchange, except Irish Free State eggs, which are wholesale prices at Liverpool. It will be seen that the price trends for these eggs were similar to those in Table V, with home-produced eggs experiencing a rather greater decline than imported.

TABLE VI.—Average Monthly Prices of Eggs at London

Month.	National Mark Standards.		Irish Free State Extra Selected.*		Danish 15½ lb.		Chinese (Green).		Polish 51-54 lb.	
	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.
	Per 120	Per 120	Per 120	Per 120	Per 120	Per 120	Per 120	Per 120	Per 120	Per 120
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
January	17 0	18 6	15 11	14 3	13 5	14 10	11 5	12 7	—	10 11
February	13 4	16 0	12 8	13 6	10 8	12 11	9 8	11 0	8 6	9 3
March ..	10 7	12 0	9 7	10 10	9 4	10 5	—	8 11	—	7 8
April ..	10 3	10 7	8 4	8 11	7 11	8 10	—	—	6 8	6 9
May ..	9 3	10 5	8 5	9 2	8 1	8 9	—	—	6 2	6 6
June ..	11 4	11 1	8 11	9 3	8 9	9 2	—	—	6 8	6 2
July ..	13 6	14 10	10 11	10 10	9 8	9 5	—	—	7 0	6 3
August ..	14 8	15 7	11 9	12 4	10 8	10 7	9 5	—	7 3	6 6
September	17 6	17 3	13 10	14 2	13 4	12 8	11 5	10 6	8 4	8 3
October ..	20 8	20 11	15 4	15 7	15 5	14 3	11 11	11 8	9 3	8 11
November	22 9	24 3	19 11	20 0	20 5	19 1	12 8	12 6	11 5	10 0
December	18 2	17 6	18 0	18 1	17 0	16 3	12 4	12 4	11 0	10 0
Average for Year.	14 11	15 9	12 9	13 1	12 1	12 3	—	—	8 3†	8 1

* At Liverpool.

† Ten months.

The price of home-produced eggs at country markets also declined slightly, on the average, in 1932. The average price at the markets in England and Wales quoted in the *Agricultural Market Report* was 1s. 4½d. per dozen, compared with 1s. 5½d. in 1931. Values in the first half of the year did not touch the previous year's level until the end of June, the low point of 10½d. per dozen reached at the end of May, comparing with the lowest price of 11½d. at the same date a year earlier: In the second six months prices were more frequently

at the 1931 level, but the seasonal peak of 2s. 3½d. touched in the second week in November was 1½d. less than the previous year's highest point, also at the same date.

Table VII shows the average monthly prices of first quality English eggs at country provision markets in England and Wales in 1932. Similar figures are given for Scottish eggs at Kilmarnock, a consuming centre, and Aberdeen, a producing centre. It is not suggested that these figures are at all comparable, but it is of interest to note that the decline at the Scottish centres, which was less marked than in England between 1930 and 1931, was of a higher order in 1932.

TABLE VII.—*Monthly Average Prices of First Quality English and Scottish Eggs*

Month.	English Farm Eggs. (a)		Scottish Farm Eggs.			
			Aberdeen.		Kilmarnock.	
	1932.	1931.	1932.	1931.	1932.	1931.
	Per dozen.	Per dozen.	Per dozen.	Per dozen.	Per dozen.	Per dozen.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
January	1 6	1 9	1 6½	1 8½	1 8½	1 10½
February	1 3½	1 5½	1 1½	1 6½	1 2½	1 6½
March	1 0	1 2	0 10½	1 3	0 11½	1 2
April	0 11	1 0	0 10½	0 11½	0 11	1 0½
May	0 10½	0 11½	0 11	0 11½	0 11	0 11½
June	1 0	1 0½	0 9½	0 11	1 0½	1 0½
July	1 3	1 3½	1 1½	1 1½	1 4½	1 4½
August	1 4½	1 5½	1 3	1 4½	1 4	1 6½
September	1 7½	1 6½	1 6½	1 7	1 8½	1 8
October	1 10½	1 11	1 8½	1 9½	2 0½	2 2
November	2 2½	2 4½	2 2½	2 4½	2 3½	2 5½
December	1 9	1 8½	1 8½	2 3½	1 9	1 10½
Average for Year.. .. .	1 4½	1 5½	1 3½	1 6	1 5½	1 6½

(a) At Representative Country Provision Markets.

IMPORTS OF EGG PRODUCTS

Imports of eggs not in shell into the United Kingdom increased to a peak in 1930. In the following year a substantial decrease occurred, and imports in 1932 showed little change, in the aggregate, compared with 1931, being larger than in any previous year except 1930. Retained imports in 1932 amounted to 763,600 cwts., the equivalent of approximately 9 million great hundreds of eggs.

Imports of liquid or frozen eggs (whole, yolk or white), the principal class of imported egg products, were slightly greater than in 1931. Imports from China, although accounting for by far the greater part of the total, were reduced by 3 per cent., but supplies from Australia, a very recent development, increased three and a half times.

Re-exports of this class of product averaged about 10 per cent. of gross imports in the five years 1927 to 1931, but have declined appreciably since 1929. A further decline occurred in 1932.

The following table shows the imports and re-exports of liquid and frozen eggs in each of the seven years, 1926 to 1932.

TABLE I.—*Imports of Liquid and Frozen Eggs (Whole, Yolk or White) into the United Kingdom*

Country whence consigned.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
China	664	628	639	741	817	764	740
Australia	—	—	—	—	—	7	24
Other Countries ..	7	12	13	7	6	3	13
Total	671	640	652	748	823	774	777
<i>Re-exports</i> ..	<i>126</i>	<i>40</i>	<i>90</i>	<i>108</i>	<i>82</i>	<i>52</i>	<i>37</i>
Net Imports ..	545	600	562	640	741	722	740

Imports of albumen as such, also mainly from China, are relatively of much less importance, but increased slightly in 1932.

Imports of dried eggs (except albumen) are also comparatively small and China is again the principal source. A considerable proportion was re-exported in previous years, but re-exports were considerably reduced in 1932.

Tables II and III show the imports of albumen and of dried eggs (except albumen) respectively, during each of the past seven years.

TABLE II.—*Imports of Albumen into the United Kingdom*

Country whence consigned.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
China	20.1	13.0	15.5	18.7	14.9	17.3	18.7
Other Countries.. ..	0.6	1.2	0.5	0.3	0.7	0.9	0.2
Total	20.7	14.2	16.0	19.0	15.6	18.2	18.9
<i>Re-exports</i>	2.7	3.1	2.8	1.8	1.0	2.3	1.8
Net Imports	18.0	11.1	13.2	17.2	14.6	15.9	17.1

TABLE III.—*Imports of Dried Eggs (except Albumen) into the United Kingdom*

Country whence consigned.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
China	24.7	22.9	14.6	14.1	12.4	8.0	4.5
Other Countries	1.1	1.0	0.6	0.6	0.4	0.3	2.4
Total	25.8	23.9	15.2	14.7	12.8	8.3	6.9
<i>Re-exports</i>	7.1	9.7	8.0	5.9	3.5	3.3	0.4
Net Imports	18.7	14.2	7.2	8.8	9.3	5.0	6.5

Imports of egg products, unlike those of eggs in shell, do not show any marked seasonal variation, although supplies tend to be heavier in the second half of the year. This tendency was much less

marked in 1932, due to the reduction in supplies in the last quarter of the year, when imports were below the level for this period in recent years. Imports were considerably above the corresponding 1931 figures in the first two months of the year, in August and September and slightly above in June; in the remaining months the previous year's imports were not attained.

Aggregate monthly imports of all classes of egg products in each of the seven years 1926 to 1932 are given in Table IV.

TABLE IV.—*Monthly Imports of Egg Products*

Month.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	68	45	36	38	61	36	60
February	25	49	60	19	33	50	111
March	57	75	52	54	39	45	16
April	25	64	17	37	36	67	33
May	23	30	51	47	21	83	76
June	133	50	78	44	97	77	86
July	67	60	61	46	100	93	76
August	99	103	68	132	95	85	104
September	96	72	23	132	80	41	130
October	42	71	186	14	138	57	30
November	23	32	25	160	70	89	41
December	60	27	26	59	81	78	40
Total	718	678	683	782	851	801	803

PRICES

No official market quotations for egg products are available. Average declared values of the imports from China show that liquid and frozen eggs have declined gradually since 1928, and a further slight decline occurred in 1932. Since 1929, the decline in prices of dried eggs, based on declared values, has been rather greater and amounted to 11 per cent. between 1931 and 1932. Following a decline of 29 per cent. in the average declared value of albumen between 1930 and 1931, an increase of about 18 per cent. was registered in 1932, compared with 1931.

Average values of the different classes of egg products from China, as declared by the Customs, are given in Table V for the eight years, 1925 to 1932.

TABLE V.—Average Declared Value of Egg Products Imported from China into the United Kingdom

Year.	Frozen or Liquid (whole, yolk or white)	Albumen.	Dried (except albumen).
	Per cwt. £	Per cwt. £	Per cwt. £
1925	4·4	18·7	15·2
1926	4·4	16·7	10·1
1927	4·4	18·7	11·8
1928	4·4	13·7	12·5
1929	4·2	14·4	14·2
1930	3·7	12·7	12·6
1931	3·4	9·0	11·9
1932	3·2	10·6	10·6

IMPORTS OF POULTRY

The trade in imported poultry (dead) into the United Kingdom increased considerably from 1928 up to a record total in 1931, but imports in 1932 were 22 per cent. less than in the previous year.

Of the poultry consumed annually in the United Kingdom, the greater part is home-produced. The rapid increase in the fowl population in recent years, although directed more towards egg production, has naturally resulted in increasing numbers being available for food. The increase continued during the past year and, in spite of the smaller imports, it is estimated that consumption of both home-produced and imported poultry was very approximately 60 million birds, or about the same as in 1931, and equal to a per capita consumption of about 5 lb. Nearly three-quarters of this figure

represented production in Great Britain and Northern Ireland. As recently as 1925 the total consumption was no more than 38 million birds.*

Source of Supply.—In 1930 and 1931 Russia figured as the chief source of imported poultry on the United Kingdom market, and again occupied this position in 1932, although supplies were 36 per cent. less than in 1931; a substantial reduction in December was mainly responsible. Imports from Hungary, the second largest source, increased slightly in December, but showed a reduction of 10 per cent. for the year as a whole. Imports from the Irish Free State have fallen off yearly since 1929 and were reduced by a further 5 per cent. in 1932, the decline occurring in the second half of the year, although the December imports were greater than a year earlier. Considerably reduced quantities were received from the principal European sources except Yugo-Slavia and Poland; of the less important sources, Denmark, Norway and Lithuania sent larger quantities. Imports from the United States were greatly reduced, but there was an increase in Southern Hemisphere and Chinese supplies.

Towards the end of the year several shipments, consisting mainly of turkeys, were received from Australia and Canada, bringing supplies from these sources well above the level of recent years. As a result, Empire supplies were increased by 10 per cent. and accounted for 24 per cent. of the total imports, as against 17 per cent. in 1931.

The comparatively small re-export trade in dead poultry has dwindled since 1928 and re-exports in 1932 totalled 11,405 cwts., compared with 14,251 cwts. in 1931.

Table I gives details of the imports of poultry (dead) into the United Kingdom in 1913, and the six years 1927 to 1932.

Apart from the countries listed in the table, large quantities of poultry are imported from Northern Ireland to Great Britain. No particulars of these imports are available, but returns issued by the Ministry of Commerce for Northern Ireland indicate that during 1932 144,697 cwts. of poultry were exported through Northern Ireland ports, as against 128,284 cwts. in 1931.

* According to preliminary figures from the Census of Agriculture Production, 1930-31, the output of poultry from agricultural holdings in England and Wales in the year ended 4th June, 1931, was approximately 22,000,000 fowls, 2,200,000 ducks, 550,000 geese and 530,000 turkeys. In addition, 6 million birds for food are estimated to have been produced on other than agricultural holdings.

TABLE I.—Imports of Poultry (Dead) into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	100 cwts.
Irish Free State	(a)	112.3	106.4	126.9	115.7	109.4	104.3
Canada	0.3	0.5	1.6	1.0	0.6	0.5	12.0
Australia	(b)	0.8	—	—	—	2.5	7.7
Union of South Africa ..	(b)	1.4	2.0	1.2	—	0.2	0.3
Other Empire Countries	0.4	—	—	0.1	—	—	—
Russia	119.9	22.4	61.1	121.9	126.4	181.3	116.6
Hungary	26.7	33.9	40.9	44.4	85.7	118.2	106.0
Yugo-Slavia	(c)	3.2	5.8	7.7	25.5	24.9	30.6
Netherlands	(c)	19.6	24.1	30.7	43.9	49.7	25.1
France	31.2	76.2	70.7	65.1	37.2	38.5	18.4
Poland	(c)	—	—	—	0.3	6.8	14.3
Italy	19.7	29.3	21.7	20.0	14.7	13.3	13.2
Austria	(d)	50.6	31.4	34.8	53.5	48.7	11.9
Norway	(c)	1.1	1.1	2.1	2.6	3.6	5.8
Germany	(c)	1.2	1.5	1.0	4.7	16.7	4.2
Belgium	1.9	22.3	21.0	16.2	10.1	10.1	2.8
Czecho-Slovakia	(c)	0.3	0.8	7.8	15.0	2.3	0.5
Switzerland	(c)	9.4	4.4	2.5	—	0.1	0.2
Denmark	(c)	—	0.7	0.2	0.1	1.2	2.4
Lithuania	(c)	—	—	0.2	0.6	0.3	2.7
Latvia	—	76.9	71.5	43.5	8.2	—	—
Argentina	(c)	5.2	3.5	4.0	5.2	10.4	16.1
Uruguay	(c)	1.2	0.8	0.2	1.9	2.9	4.1
United States of America	54.2	34.3	19.0	9.7	13.3	14.1	2.6
China	20.0	3.2	0.1	12.9	4.0	7.4	15.5
Other Foreign Countries..	4.1	0.4	0.1	0.1	0.7	2.4	1.8
Total Empire Countries ..	0.7	115.0	110.0	129.2	116.3	112.6	124.3
Total Foreign Countries..	277.7	390.7	380.2	425.0	453.6	552.9	394.8
Total All Countries ..	278.4	505.7	490.2	554.2	569.9	665.5	519.1
Re-exports	9.9	12.4	21.4	20.6	15.2	14.3	11.4
Net Imports	268.5	493.3	468.8	533.6	554.7	651.2	507.7

(a) Not separately distinguished before April, 1923.

(b) Included in Other Empire Countries.

(c) Included in Other Foreign Countries.

(d) Included in the total for Hungary.

Seasonal Variation.—Imports of poultry in December are much greater than in any other month of the year. The quantity imported in December, 1932, was 19 per cent. less than in the same month of 1931 and accounted for 38 per cent. of the year's imports, against 37 per cent. in the previous year. Supplies are normally lightest during the summer months, but in 1931 there had been some slight tendency towards a more even distribution of imports throughout the year. Imports in the summer of 1932, however, were below the average for this period in recent years, due to the greatly reduced quantities from the Netherlands, usually the principal supplier at that time, and from other European countries. In February and April supplies exceeded the previous year's level, due largely to increased quantities from Russia and other European countries, but in all other months imported supplies were less than a year previously.

Monthly imports of dead poultry in 1913, 1924 and 1928 to 1932 are given in Table II.

TABLE II.—*Monthly Imports of Poultry (Dead) into the United Kingdom.*

Month.	1913.(a)	1924.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	44	11	61	79	76	61	49
February	65	21	32	28	61	60	78
March	42	17	52	38	48	60	30
April	11	23	33	59	37	30	35
May	4	26	19	35	28	37	22
June	2	5	15	10	9	19	8
July	1	15	11	9	12	15	5
August	8	9	11	13	14	20	8
September	6	7	11	12	20	21	23
October	2	10	20	21	36	38	22
November	5	14	33	37	50	60	41
December	88	125	192	213	179	244	198
Total	278	283	490	554	570	665	519

(a) Excluding imports from the Irish Free State.

Monthly imports of dead poultry during 1932, by country or group of countries of despatch, are shown in Table III.

TABLE III.—*Monthly Imports of Poultry (Dead) into the United Kingdom during 1932.*

Month.	Irish Free State.	Netherlands, Belgium, France.	Austria and Hungary.	Russia.	United States of America and Argentina.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	7.1	4.2	12.2	18.5	—	7.5	49.5
February	7.1	5.7	12.3	35.4	0.2	17.4	78.1
March ..	7.1	2.8	0.5	10.3	0.3	9.2	30.2
April ..	4.6	2.0	0.3	25.2	1.1	1.6	34.8
May ..	3.1	1.1	0.1	11.6	1.0	5.1	22.0
June ..	2.5	1.2	—	2.0	0.5	1.7	7.9
July ..	1.4	1.5	—	0.9	0.8	0.5	5.1
August ..	1.2	1.7	—	0.4	3.0	1.4	7.7
September	2.5	3.2	2.0	2.9	7.3	5.0	22.9
October ..	4.5	2.8	5.1	0.3	4.0	5.1	21.8
November	7.0	1.7	20.8	1.7	0.2	9.4	40.8
December	56.2	18.3	64.6	7.4	0.4	51.4	198.3
Total ..	104.3	46.2	117.9	116.6	18.8	115.3	519.1

LIVE POULTRY

The trade in imported live poultry has tended to decline in recent years, although an increase occurred in 1931. Imports in 1932 were 23 per cent. less than in 1931 and the smallest recorded since separate figures have been available for the Irish Free State. Supplies from the Irish Free State, which comprised 84 per cent. of the total in 1932 against 92 per cent. in 1931, declined by 30 per cent., but larger quantities were received from other countries, details of which are not yet available. In previous years these were mainly from Belgium and had been declining.

The seasonal variation in imports of live poultry is rather different to that for dead poultry. Supplies are at a minimum in the second quarter of the year and heaviest from September to November, when they probably consist of birds for fattening in preparation for the Christmas market. A decline commences from December onwards. This trend was also apparent in 1932, but imports in December were considerably under the normal level for that month.

Table IV shows the imports into the United Kingdom of live poultry from the principal sources in the nine years, 1924 to 1932, and Table V monthly imports in each of the eight years 1925 to 1932.

TABLE IV.—*Imports of Live Poultry into the United Kingdom.*

Year.	Countries whence consigned.				
	Irish Free State.	Belgium.	Italy.	Other Countries.	Total.
	000's.	000's.	000's.	000's.	000's.
1924	1,128	106	153	18	1,405
1925	1,074	117	58	16	1,265
1926	1,126	138	26	16	1,306
1927	1,105	172	29	16	1,322
1928	1,021	128	25	8	1,182
1929	1,073	109	6	16	1,204
1930	971	105	3	13	1,092
1931	1,055	75	3	12	1,145
1932	733	(a)	(a)	143	876

(a) Included in Other Countries.

TABLE V.—*Monthly Imports of Live Poultry.*

Month.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.
	000's.	000's.	000's.	000's.	000's.	000's.	000's.	000's.
January ..	94	101	109	93	88	95	97	93
February ..	91	119	88	100	98	82	89	80
March	90	111	131	93	80	88	81	64
April	63	67	91	73	75	52	44	48
May	58	35	62	50	44	53	38	45
June	63	68	74	56	54	48	42	53
July	107	92	95	90	80	70	81	58
August	125	124	96	115	119	99	106	72
September ..	143	155	133	124	159	119	128	113
October	164	168	153	133	165	152	150	115
November ..	144	142	162	139	123	128	179	98
December ..	123	124	128	116	119	106	110	37
Total	1,265	1,306	1,322	1,182	1,204	1,092	1,145	876

PRICES

Between 1930 and 1931, poultry prices declined to a less extent than most other food commodities. Quotations for British chickens throughout 1932, however, were on an appreciably lower level than in 1931. The seasonal increase was less pronounced and the seasonal high point in April was considerably lower than the 1931 peak. From June onwards, however, the decline was less marked and towards the end of the year prices were only slightly below those of a year earlier. Quotations for British duckling experienced a pronounced and rapid fall from an unusually high point in April, but recovered towards the end of the year and, for the year as a whole, compared favourably in price with 1931. The price of Irish Free State chicken was well maintained, relative to 1931, particularly in the last quarter of the year.

Table VI. gives average monthly wholesale prices of certain descriptions of chicken and duck during 1931 and 1932, as quoted in the *Agricultural Market Report*.

TABLE VI.—*Monthly Average Prices of Certain Classes of Poultry*

Month.	British Chicken at London (1st quality).		Irish Free State Chicken at Liverpool (1st quality).		British Ducklings at London (1st quality).	
	1932.	1931.	1932.	1931.	1932.	1931.
	Per lb. s. d.	Per lb. s. d.	Per lb. s. d.	Per lb. s. d.	Per lb. s. d.	Per lb. s. d.
January	1 5	1 7	1 1½	1 2	1 0	1 2
February	1 5	1 8	1 0½	1 2	1 1½	1 3
March	1 6½	1 10	1 2	1 2	1 5½	1 5½
April	1 7	2 0	1 2	1 3	2 0	1 8
May	1 6½	2 0	—	1 3	1 6	1 7½
June	1 4½	1 10	—	1 3	1 2½	1 3½
July	1 3½	1 8	0 11½	1 2	0 11	1 3
August	1 3	1 5½	0 11	1 1½	0 10½	0 11½
September	1 3½	1 5	0 11	0 11½	0 9½	0 10½
October	1 3	1 4	0 11	0 11	0 10½	0 9½
November	1 3	1 4	0 11	0 11	0 10½	0 9½
December	1 3½	1 5	1 0½	1 0½	1 0	0 11
Average for Year ..	1 4½	1 7½	—	1 1½	1 1½	1 2

Table VII shows the top prices for certain descriptions of poultry as quoted on the London Central Markets in each Wednesday during December, 1932, in comparison with prices for the corresponding day in 1931. The figures are intended merely to serve as an indication of the trade when supplies are greatest.

TABLE VII.—*Representative Smithfield Quotations for First Quality Poultry during December.*

Date.	Chicken.							
	English Surrey.		Dutch White.		Belgian.		Hungarian.	
	1932.	Same Day 1931.	1932.	Same Day 1931.	1932.	Same Day 1931.	1932.	Same Day 1931.
	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
<i>Wednesday</i>								
30th November ..	1 4	1 4	1 3	1 3	1 4	1 3	0 11	—
7th December ..	1 4	1 5	1 4	1 3	1 4	1 4	0 11	—
14th December ..	1 5	1 7	1 4	1 3	—	1 5	1 0	—
21st December ..	1 6	1 7	1 4	1 4	—	1 5	1 0	—
<i>Thursday</i>								
29th December ..	1 5	1 6	1 4	1 3	—	1 5	0 11½	—

Date.	Turkeys.								Geese.	
	English.		Irish.		Hungarian.		Italian.		English.	
	1932.	Same Day 1931.	1932.	Same Day 1931.	1932.	Same Day 1931.	1932.	Same Day 1931.	1932.	Same Day 1931.
	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.	Per lb.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
<i>Wednesday</i>										
30th November	—	—	—	—	0 11	—	1 0	—	0 10	0 9½
7th December	—	—	1 5	—	0 11½	—	1 1	—	0 10½	0 9½
14th December	—	—	1 6	1 7	1 2	1 2	1 2	1 3½	0 11	1 0
21st December	1 5	2 0	1 2	1 8	0 9	1 3	1 0	1 5	0 10	0 11
<i>Thursday</i>										
29th December	—	—	—	—	—	—	—	—	0 10	0 9½

THE BACON MARKET IN 1932

The expansion of the European pig population, culminating in record numbers for many countries in 1931, led to a marked increase in bacon supplies to the United Kingdom, an increase which was carried into 1932. By the end of 1931, however, unremunerative returns were beginning to take effect in restricted pig-breeding and in the 1932 estimate for the principal exporting countries this tendency was more apparent. As a result, imports of bacon in the second half of the year were already on a declining scale and tending to drop below the 1931 rate. A temporary increase occurred towards the end of the year, prior to the coming into force of a voluntary agreement on the part of foreign exporting countries to restrict their supplies of bacon to a fixed quantity. For the year as a whole, gross imports of bacon into the United Kingdom reached the record figure of 11,405,932 cwts., an increase of 2 per cent. compared with 1931 and 24 per cent. greater than in 1930. Re-exports were substantially reduced, and the increase in net imports, compared with 1931, amounted to 4 per cent.

Annual figures of the home production of bacon are not available. According to the Board of Trade Census of Production, the production of bacon and hams during 1930 in factories in Great Britain employing more than ten persons amounted to 1,238,000 cwts., of which 998,000 cwts. were bacon.* Northern Ireland also figures as a considerable source of bacon and hams, and it is estimated that the gross output of the pig and bacon industries in the period of 1926 to 1930 represented an average annual production of 410,000 cwts. of bacon and hams, including imports of pigs and pork from the Irish Free State, for curing in Northern Ireland.

An important feature in the bacon trade during 1932 was the adoption by the United Kingdom Government of the principle of regulated supplies in the form of a quota control over home production and imports. A figure of total supplies was suggested by the Re-organisation Commission for Pigs and Pig Products, and a scheme submitted whereby home production would increase at the expense of imports from foreign sources. It was intended that the scheme should come into operation as from 1st July, 1933, but a voluntary

* In addition, some 1,595,000 cwts. of smoked bacon and hams (mainly bacon) were returned, but these are understood to represent imported produce smoked in Great Britain.

agreement restricting imports from most foreign countries came into force on 23rd November, 1932, for a period of two months, the reduction being based on supplies from each country in a basic period and amounting, in the aggregate, to about 16 per cent. on the previous year's import. The restriction was continued, on a slightly diminishing scale of imports, until 22nd June, 1933.

Sources of Supply.—The predominant position of Denmark on the United Kingdom bacon market was maintained in 1932, that country increasing its supplies by 5 per cent. and accounting for over two-thirds of total imports, or practically the same proportion as in 1931. Imports from Poland, which had grown rapidly in the preceding four years, increased by a further 6 per cent. in 1932. Imports from the Netherlands were greatly reduced in the early part of the year, but, following Government measures to aid the industry, an increase occurred in the last few months; for the whole year a decline of 3 per cent. was recorded. The marked advance in imports from Lithuania noted in 1931 was continued to a less pronounced extent in 1932, an increase of 42 per cent. enabling that country to displace Sweden, supplies from which were reduced by 25 per cent., as the fourth most important source of imported bacon; in three years imports from Lithuania have grown from 5,000 cwts. to half a million cwts. The main feature in supplies from other foreign countries was a further marked diminution in bacon imports from the United States, which were only one-third of the 1931 figure, and a much smaller fraction of the amount shipped in any other recent year. Increased quantities were received from Russia and Baltic countries except Latvia, and decreased supplies from Argentina; imports from Germany were reduced to negligible proportions.

Among Empire supplying countries, imports from the Irish Free State, which have declined steadily since 1928, were reduced by a further 33 per cent. to the smallest figure recorded since separate returns have been available. Imports of Canadian bacon, which had been declining over a period of years, showed a substantial recovery, and total Empire supplies were 10 per cent. greater than in 1931, although comprising only 3 per cent. of the aggregate from all countries, or little more than in 1931.

There is also a considerable trade in bacon from Northern Ireland to Great Britain, which is not included in the figures of imports.

Details are not available, but in 1932 the export of bacon through Northern Ireland ports amounted to 154,562 cwts., as compared with 171,456 cwts. in 1931.

TABLE I.—Imports of Bacon into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Irish Free State	(a)	451	555	497	331	297	199
Canada	244	503	307	199	99	50	183
Australia	(d)	—	1	—	2	1	1
Other Empire Countries ..	6	2	—	—	1	—	1
Denmark	2,335	5,091	5,376	4,977	6,118	7,339	7,672
Poland	(b)	116	118	305	483	1,077	1,143
Netherlands	186	797	1,061	902	842	1,000	972
Lithuania	(c)	2	2	5	73	362	515
Sweden	62	474	441	380	550	577	430
Estonia	(c)	50	41	25	25	64	82
Russia	212	114	197	209	50	29	43
Finland	(c)	—	—	—	5	35	38
Latvia	(c)	164	145	67	47	31	19
Germany	(e)	24	21	5	17	29	2
Hungary	(e)	—	—	6	24	1	—
United States of America	1,803	641	538	635	479	189	63
Argentina	(e)	51	49	58	38	50	39
Other Foreign Countries	11	2	1	8	7	3	4
Total Empire Countries	250	956	863	696	433	348	384
Total Foreign Countries	4,609	7,526	7,990	7,582	8,758	10,786	11,022
Total All Countries ..	4,859	8,482	8,853	8,278	9,191	11,134	11,406
<i>Re-exports :—</i>							
<i>Irish Free State ..</i>	(a)	334	297	307	307	329	128
<i>Other Empire Countries</i>	38	25	26	28	27	31	37
<i>Foreign Countries ..</i>	71	30	26	16	23	30	37
<i>Total Re-exports</i>	109	389	349	351	357	390	202
Net Imports	4,750	8,093	8,504	7,927	8,834	10,744	11,204

(a) Not separately distinguished before April, 1923.

(b) Included in Russia, Germany and Austria-Hungary.

(c) Included in Russia.

(d) Included in Other Empire Countries.

(e) Included in Other Foreign Countries.

Exports of imported bacon increased between 1928 and 1931, but shipments in 1932 were little more than half the previous year's figure and below the level of recent years. The Irish Free State is the principal market for these re-exports, and smaller shipments to that country, following increased tariff rates early in the year, accounted for the smaller total figure. Larger quantities were taken by other countries.

Table I gives details of the gross and net imports of bacon into the United Kingdom in 1913, and the six years 1927 to 1932.

Seasonal Variation.—There is no marked seasonal fluctuation in supplies of imported bacon. Imports increased in the first three months of 1932 to a record figure in March and substantially exceeded the previous year's level. The cessation of Danish killings for a few weeks, on account of labour troubles, caused a sharp drop in supplies during May, but for the first half of 1932 imports were 7 per cent. greater than in the same period of 1931. In the following quarter imports were 3 per cent. less than a year previously. October and November supplies again exceeded those of a year ago, but the quantity imported in December, the first complete month to be affected by the restrictive measures, was 16 per cent. less than a year earlier.

Table II shows the monthly imports of bacon into the United Kingdom in 1913, and the six years 1927 to 1932.

TABLE II.—*Monthly Imports of Bacon into the United Kingdom*

Month.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	350	673	735	786	668	851	903
February ..	367	624	760	612	658	890	1,005
March ..	427	736	777	615	756	834	1,123
April ..	460	636	748	653	671	888	966
May ..	405	684	793	784	755	965	795
June ..	379	789	771	642	744	974	989
July ..	445	751	707	717	763	943	915
August ..	424	665	776	735	757	951	932
September ..	376	716	641	656	788	946	907
October ..	417	764	736	646	855	974	1,020
November ..	374	711	708	668	771	941	1,022
December ..	434	733	701	764	1,005	977	829
Total ..	4,858	8,482	8,853	8,278	9,191	11,134	11,406

Table III shows the monthly imports of bacon from the principal sources during 1932.

TABLE III.—*Monthly Imports of Bacon into the United Kingdom during 1932*

Month.	Irish Free State.	Canada.	Denmark.	Netherlands and Sweden.	Russia and Baltic Countries. (a)	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	17	3	655	42	166	20	903
February ..	18	17	672	96	184	18	1,005
March ..	15	24	786	81	205	12	1,123
April ..	13	14	679	101	151	8	966
May ..	21	25	435	151	150	13	795
June ..	13	23	738	97	107	11	989
July ..	11	31	644	86	128	15	915
August ..	11	11	625	132	143	10	932
September ..	15	11	603	146	125	7	907
October ..	19	9	676	179	126	11	1,020
November ..	28	4	629	169	181	11	1,022
December ..	18	11	530	122	136	12	829
Total ..	199	183	7,672	1,402	1,802	148	11,406

(a) Poland, Estonia, Latvia, Lithuania.

PRICES

The drastic fall in bacon prices which commenced in the second half of 1930, was continued into 1932. Prices remained fairly steady from the middle of January until April, although on an appreciably lower level than a year earlier. Shortage of Danish supplies following the temporary cessation of killings caused a rapid rise throughout May, until the previous year's level was exceeded. A reaction followed, but the steady trade in June kept prices higher than a year earlier. The increase in the two following months was less pronounced than in 1931, but by September prices were again in excess of the preceding year. A sharp decline ensued, but news of projected measures for restricting imports caused an upward movement from the beginning of November until prices were well above the level of a year earlier. A slight temporary reduction occurred during the

TABLE IV.—Average monthly Prices of Bacon at London.

Month.	British Wiltshire Green*.		Irish Free State Lean Sizeable.		Danish No. 1 Sizeable.	
	1932.	1931.	1932.	1931.	1932.	1931.
	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
January	88 6	114 9	77 9	102 6	52 0	66 6
February	92 0	120 0	79 0	104 6	52 0	64 0
March	93 3	109 6	80 6	101 6	55 6	68 6
April	94 6	106 0	86 6	102 0	55 6	78 0
May	101 6	106 3	90 0	98 6	66 0	68 0
June	89 3	90 6	88 0	91 6	60 0	57 6
July	83 6	86 9	86 0	90 0	57 6	65 6
August	82 0	93 0	88 0	89 3	67 6	73 0
September	83 0	87 6	85 6	80 6	66 9	62 9
October	75 6	79 3	72 0	82 3	53 0	60 6
November	74 9	75 6	63 6	75 6	57 0	51 0
December	81 0	78 9	69 3	70 0	64 6	48 6
Average for year ..	86 6	95 9	80 6	90 9	59 0	63 9

Month.	Polish No. 1 Sizeable.		Dutch No. 1 Sizeable.		Swedish No. 1 Sizeable.	
	1932.	1931.	1932.	1931.	1932.	1931.
	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
January	42 3	55 0	49 0	61 9	50 0	62 6
February	41 9	49 0	48 3	57 0	50 0	58 3
March	43 6	55 6	48 3	60 9	51 6	64 3
April	45 3	61 3	49 6	67 3	52 0	73 6
May	60 9	46 6	63 9	56 6	65 6	58 0
June	52 0	41 3	56 0	49 0	58 0	50 9
July	47 9	53 6	53 3	58 9	55 6	60 9
August	56 3	61 3	58 0	66 3	65 6	69 9
September	56 0	51 6	59 3	56 6	64 9	58 9
October	44 3	51 0	44 9	56 6	50 6	57 9
November	50 9	42 0	50 9	47 3	56 6	48 3
December	53 0	41 0	55 6	45 6	62 0	46 6
Average for year ..	49 6	50 6	53 0	57 0	56 9	59 0

* Average wholesale price at Bristol.

last week of the year. For the year, as a whole, prices of imported bacon were slightly less than in 1931, the decline amounting to 7 per cent. in the case of Danish and Dutch. Between 1930 and 1931 bacon prices had declined by about 35 per cent., compared with about 15 per cent. between 1929 and 1930. The reduction in the case of the higher-priced Irish and home-produced bacon was rather greater than for other descriptions, but they had fallen less in the previous year.

Average monthly prices of certain descriptions of bacon in 1932 and 1931 are shown in Table IV. The figures, except for British Wiltshire bacon, are taken from the weekly quotations of the London Provision Exchange and represent the highest average of a series. The range of quotations within each grade is comparatively small, except for Irish Lean Sizeable, where the range may be as great as 20s. Prices for British Wiltshire (green) bacon refer to wholesale prices on the Bristol market.

Figure 5 shews in diagrammatic form the trend of prices of Canadian and Danish bacon from 1929 to 1932.

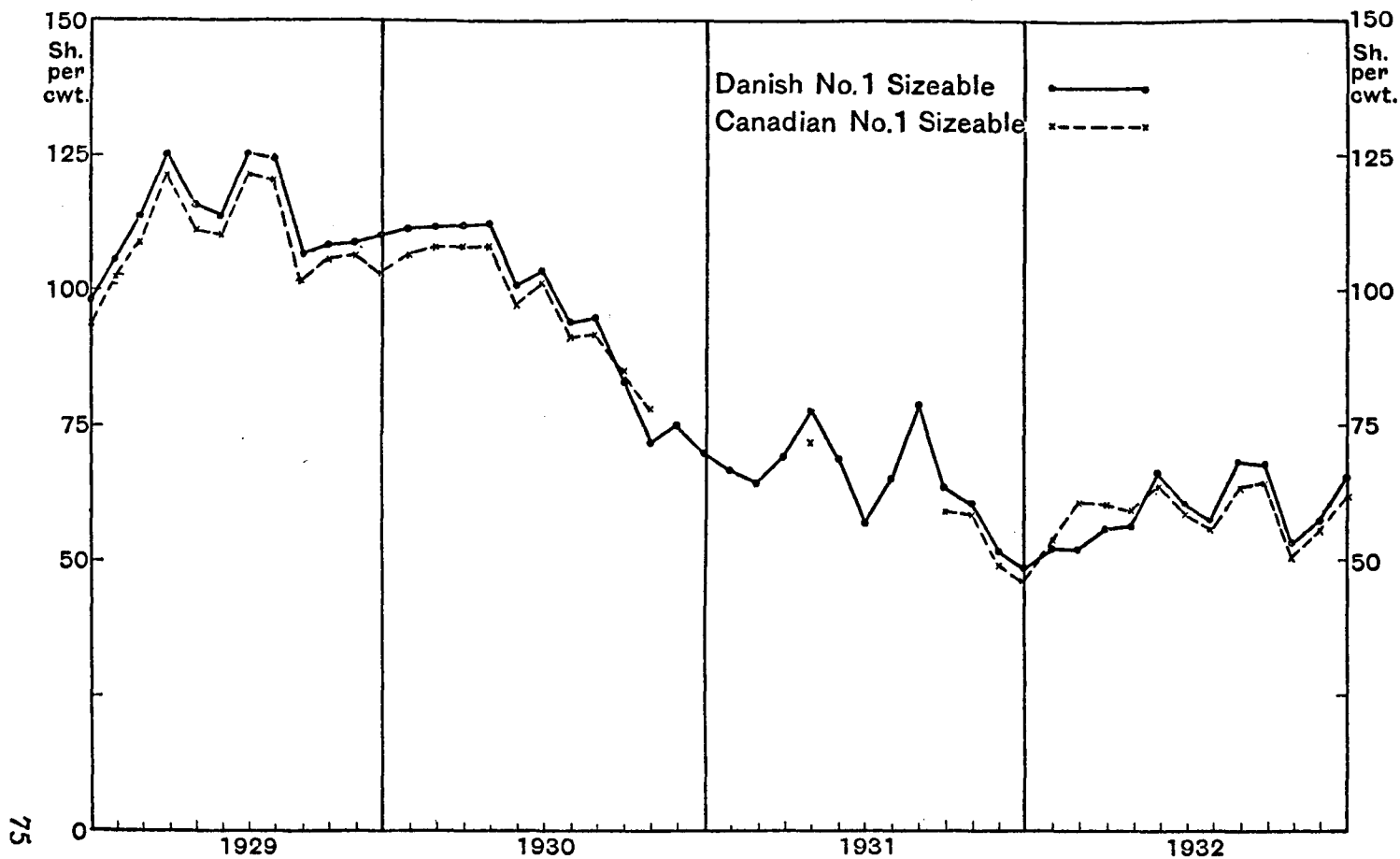
IMPORTS OF HAMS

The bulk of the ham consumed in the United Kingdom is imported, although the disparity is rather less marked than in the case of bacon. The production of hams in Great Britain in 1930, the latest year for which figures are available, amounted to 240,000 cwts. in factories employing more than ten persons, compared with 233,000 cwts. in 1924. In addition, 140,000 cwts. of smoked hams were returned, but these are understood to represent imported produce smoked in this country.

Imports of hams into the United Kingdom have tended to decline with the development of imports of mild-cured bacon, and have fallen off rapidly since 1929; in the past two years they have been below the average for the 1909-13 period. Gross imports in 1932 amounted to 803,353 cwts., or less than in 1931 and 1930 by 3 per cent. and 20 per cent. respectively.

Bacon and hams were considered as one commodity in the voluntary agreement to restrict imports, which came into operation towards the end of 1932 (see p. 68).

FIG. 5. PRICE OF CANADIAN AND DANISH BACON AT LONDON, 1929-1932.



Sources of Supply.—The United States is by far the chief source of imported hams on the United Kingdom market, but supplies have declined appreciably since 1929. Imports from this source were reduced by 23 per cent. in 1932 and accounted for 58 per cent. of the total from all countries, a much smaller proportion than in any other recent year and comparing with 72 per cent. in 1931; towards the end of the year, however, supplies of United States hams were beginning to exceed the previous year's level. After declining over a period of years imports from Canada recovered in 1932 and were twice as heavy as in 1931. The rapid development of supplies from Poland in the past few years was continued to a less marked extent

TABLE I.—*Imports of Hams into the United Kingdom.*

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Canada	90·1	133·7	115·3	98·2	84·0	72·5	143·5
Irish Free State	(a)	12·3	17·4	15·4	15·3	17·2	14·8
Australia	(b)	0·1	0·7	—	4·9	0·6	—
Other Empire Countries ..	0·1	0·5	—	0·1	0·1	0·1	—
Poland	(c)	7·2	15·9	28·4	42·8	102·2	118·6
Denmark	1·2	2·6	1·9	1·3	2·9	2·6	6·4
Belgium	(c)	2·9	0·3	0·5	1·0	0·1	—
Netherlands	(c)	0·9	0·3	0·8	1·4	0·8	1·5
Germany	(c)	0·1	0·2	0·3	0·5	2·2	0·4
United States of America	760·6	716·1	759·8	841·7	820·4	600·6	465·2
Argentina	(c)	9·8	27·6	39·8	25·5	28·6	49·8
Brazil	(c)	0·5	—	0·3	2·5	3·0	1·4
Other Foreign Countries..	3·0	2·0	2·6	2·0	1·7	0·6	1·8
Total Empire Countries ..	90·2	146·6	133·4	113·7	104·3	90·4	158·3
Total Foreign Countries ..	764·8	742·1	808·6	915·1	898·7	740·7	645·1
Total All Countries ..	855·0	888·7	942·0	1,028·8	1,003·0	831·1	803·4
<i>Re-exports</i>	29·9	24·8	23·8	23·4	19·1	15·8	12·7
Net Imports	825·1	863·9	918·2	1,005·4	983·9	815·3	790·7

(a) Not separately distinguished before April, 1923.

(b) Included in Other Empire Countries.

(c) Included in Other Foreign Countries.

in 1932, an increase of 16 per cent. being recorded. There was a considerable increase to nearly 50,000 cwts. in imports from Argentina and the comparatively small quantity from Denmark was well above the level of recent years. Imports from the Irish Free State declined by 14 per cent.

As a result of the increased imports from Canada, Empire supplies of hams in 1932 were 75 per cent. larger than in 1931 and accounted for 20 per cent. of total imports, a larger proportion than in other recent years and compared with 11 per cent. in 1931.

Northern Ireland is also an important source of hams, although the figures are not, of course, included as imports. Exports of hams through Northern Ireland ports in 1932 totalled 96,062 cwts., as compared with 103,644 cwts. in 1931.

Exports of imported hams from the United Kingdom are comparatively small and have been declining, the total of 12,726 cwts. in 1932 being 20 per cent. less than in 1931.

Table I gives details of the gross and net imports of hams in the years 1913 and 1927 to 1932.

Imports of hams tend to be heaviest during the summer months, coinciding with the period when demand is greatest.

The low level to which imports had fallen in 1931 was continued in 1932 and in the first half of the year the reduction compared with a year earlier amounted to 12 per cent. In the following five months, however, the rate of importation was in excess of 1931, chiefly as a result of increased quantities from Canada and, to a less extent, from Poland. Supplies again dropped below the previous year's figure in December. The month of heaviest importation, as is usual, proved to be July, while imports were smallest in January; in 1931 March was the month of lightest supply.

Monthly imports of hams in 1913, 1924, and 1927 to 1932 are given in Table II.

Monthly imports of hams in 1932 from the chief sources of supply are given in Table III.

TABLE II.—*Monthly Imports of Hams into the United Kingdom*

Month.	1913.	1924.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	68	101	79	62	78	70	63	41
February ..	70	187	58	81	74	71	58	46
March ..	59	152	62	83	61	77	48	58
April ..	85	126	58	71	80	85	68	52
May ..	66	158	82	83	126	110	82	86
June ..	64	143	105	96	94	98	87	76
July ..	90	171	102	102	108	128	100	104
August ..	84	156	74	121	108	107	66	81
September ..	74	115	79	67	72	64	50	62
October ..	64	82	70	50	72	52	65	67
November ..	68	150	52	60	73	51	67	71
December ..	63	95	68	66	83	90	77	59
Total ..	855	1,636	889	942	1,029	1,003	831	803

TABLE III.—*Monthly Imports of Hams into U.K. in 1932*

Month.	Irish Free State.	Canada.	United States of America.	Poland.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	1.1	7.0	21.6	7.6	3.8	41.1
February ..	1.0	6.7	23.2	9.4	5.7	46.0
March ..	1.2	9.8	31.9	11.2	4.2	58.3
April ..	0.9	7.4	31.2	8.6	3.4	51.5
May ..	0.9	14.8	54.5	12.8	3.3	86.3
June ..	0.8	12.8	51.7	7.4	2.9	75.6
July ..	1.2	20.7	61.6	11.6	9.0	104.1
August ..	0.8	15.9	43.9	14.7	5.9	81.2
September ..	1.4	15.5	30.7	9.4	5.3	62.3
October ..	1.6	12.6	41.0	7.0	4.7	66.9
November ..	2.3	10.4	39.8	12.3	6.6	71.4
December ..	1.6	9.9	34.1	6.6	6.5	58.7
Total ..	14.8	143.5	465.2	118.6	61.3	803.4

PRICES

Prices for hams, particularly of imported hams, are subject to the same forces which affect bacon prices and tend to move on an approximately similar basis. Prices for United States hams in the first few months of 1932 were relatively steady at an appreciably lower level than a year previously. An increase in May, following light supplies, brought prices practically to the previous year's figure. A peak was reached in July and a seasonal decline ensued, with quotations fairly steady in the last two months of the year. The average price decline between 1931 and 1932 was about 12 to 15 per cent., following a 20 per cent. reduction in the previous year. Prices for home-produced hams declined until August, remaining considerably lower than a year earlier, but the seasonal increase which followed brought prices fully up to the corresponding 1931 level. The average price decline from 1931 to 1932 was about 10 per cent.

TABLE IV.—Average Price of Hams at London

Month.	York and Cumberland 14/16s.			United States (a) 12/14s.		
	1930.		1931.		1932.	
	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.	Per cwt. s. d.
January	200 0	194 0	150 0	102 6	87 9	70 3
February	200 0	180 0	145 0	105 0	75 3	72 0
March	200 0	170 3	140 0	97 6	73 6	71 6
April	200 0	170 0	138 0	99 0	75 6	71 6
May	194 0	160 0	135 0	93 6	75 6	75 0
June	190 0	145 0	135 0	101 3	73 3	70 3
July	190 0	140 0	132 0	112 0	80 6	76 6
August	190 0	140 0	130 0	97 6	81 6	72 0
September	197 6	143 0	144 0	91 6	83 6	71 6
October	210 0	150 0	150 0	91 6	88 9	61 6
November	217 6	150 0	150 0	97 6	69 6	62 3
December.. .. .	213 3	150 0	150 6	93 9	69 0	62 3
Average for year.. .. .	200 3	157 9	141 6	98 6	77 9	69 9

(a) Short Cut, Green.

Table IV shows the average monthly top prices during 1930, 1931 and 1932 of York and Cumberland 14/16s. and American short cut 12/14s. as quoted on the London Provision Exchange. It should be noted that these two descriptions are not comparable in any way; neither is it suggested that the figures represent a price at which the

bulk of sales took place. At the same time the figures give some idea of the seasonal change in prices in the past three years and indicate the extent of the decline which occurred between 1930 and 1932.

IMPORTS OF FRESH PORK

No information is available regarding the quantity of pigmeat marketed as fresh pork in the United Kingdom. According to the Ministry of Agriculture, the total output of pigmeat in Great Britain during 1931 amounted to 5,648,000 cwts. compared with 5,086,000 cwts. in 1930. Adding the output for Northern Ireland, the United Kingdom figures become 6,215,000 cwts. and 5,610,000 cwts. in 1931 and 1930 respectively. It is estimated* that in 1930 rather over one-quarter of the output in Great Britain consisted of bacon and hams, and the remainder of pork, lard and offals. It is evident that the bulk consists of pork and that home production accounts for the greater quantity of fresh pork consumed in Great Britain.

The foregoing estimates are based on the average number of sows at the June census, and as the number of sows in Great Britain on 4th June, 1932, was over 5 per cent. greater than a year earlier it is probable that the output of pigmeat showed a further increase last year. The number of fat pigs (baconers and porkers) marketed at representative markets in Great Britain in 1932 amounted to 889,000 compared with 748,000 in 1931. Supplies of British pork (England and Wales and Scotland) at Smithfield Market during 1932 totalled 563,880 cwts. as against 438,540 cwts. in 1931.

Imports of fresh pork into the United Kingdom in 1932 were 32 per cent. less than in 1931 and the smallest in recent years. Since 1927 imports of fresh pork have been solely from the Irish Free State. Prior to that date there was a large and growing importation from European countries, particularly the Netherlands, but these ceased as a result of the embargo on Continental fresh meat imposed in 1926. Imports from the Irish Free State increased to a peak in 1928, declined in the two following years and again increased substantially in 1931. Irish Free State supplies in 1932 were the smallest since 1926. During the five years 1927 to 1931 land boundary trade accounted on the average for 60 per cent. of these imports, mainly for conversion into bacon in Northern Ireland, but imports across the land boundary in 1932, totalling 131,123 cwts., comprised almost exactly 50 per cent. of the total.

* Report of the Reorganisation Commission for Pigs and Pig Products.

Throughout 1932 the rate of importation was less than a year earlier, the decline being particularly marked in the summer months, when supplies are normally light. A pronounced seasonal increase set in during the last quarter of the year, but the previous year's corresponding figures were not attained. As in 1931, imports were heaviest in November; August was the month of minimum supply, whereas in the previous year imports were lightest in June.

Table I shows the imports of fresh pork into the United Kingdom from the chief sources in the nine years 1924 to 1932 and Table II the monthly imports in the six years 1927 to 1932.

TABLE I.—*Imports of Fresh Pork into the United Kingdom*

Year.	Irish Free State.	Netherlands.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
1924	248	535	25	808
1925	180	820	12	1,012
1926	203	381	54	638
1927	317	—	—	317
1928	388	—	—	388
1929	296	—	—	296
1930	289	—	—	289
1931	383	—	—	383
1932	262	—	—	262

TABLE II.—*Monthly Imports of Fresh Pork*

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January ..	23	36	31	23	35	22
February ..	21	36	39	23	34	29
March ..	26	36	32	22	31	30
April ..	21	31	20	22	25	21
May ..	16	25	16	19	20	15
June ..	21	23	16	10	14	9
July ..	15	16	10	14	17	6
August ..	13	14	12	11	14	4
September ..	25	32	25	27	34	9
October ..	36	42	29	37	45	30
November ..	47	52	28	39	59	45
December ..	53	45	38	42	55	42
Total ..	317	388	296	289	383	262

IMPORTS OF FROZEN AND SALTED PORK

(i) Frozen Pork.

The trade in imported frozen pork into the United Kingdom was of minor importance in pre-war years, but a considerable expansion occurred during the war and in the years immediately following. After 1920 imports were on a smaller level, but an increase occurred in each year from 1927 to 1931. Imports in 1932 were less than in 1931 and 1930 by 7 per cent. and 3 per cent. respectively.

New Zealand maintained its position as chief source of imported frozen pork in 1932, supplying 8 per cent. more than in 1931. Imports from Canada doubled, but there was a marked decline in Australian supplies, which had developed rapidly in the two preceding years.

The total quantity from Empire sources was 10 per cent. less than in 1931, and comprised 58 per cent. of total imports, compared with 60 per cent. in the earlier year.

There has been a steady growth of imports from Argentina in recent years, and a further increase of 34 per cent. occurred in the year under review. Supplies from the United States, however, declined to approximately one-half of the 1931 figure, and the aggregate imports from other countries were slightly reduced.

Table I gives details of the imports of frozen pork into the United Kingdom in 1913 and the six years from 1927 to 1932.

Imports of frozen pork are normally at their maximum during the winter and lightest in spring and summer, but with the growing importance of the Southern Hemisphere as a source, supplies have been more evenly spread throughout the year; in 1932, indeed, imports were greatest during the summer months. The rate of importation was generally under the previous year's level except during summer and in October when increased quantities were registered as a result of heavier arrivals from the Southern Hemisphere, particularly Argentina, and from Canada. Monthly imports of frozen pork in 1924 and in each of the years 1927 to 1932 are given in Table II.

TABLE I.—Imports of Frozen Pork into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
New Zealand	(a) 86	86	122	170	137	122	131
Australia	(a) 2	2	1	—	23	86	46
Canada	(a) 12	12	6	2	3	10	20
Other Empire Countries	3	1	—	—	1	—	—
Argentina	—	45	58	69	74	81	109
United States of America	12	39	58	47	109	62	32
Brazil	—	1	2	1	2	3	2
China	1	1	—	6	1	—	—
Other Foreign Countries	—	—	—	2	2	2	1
Total Empire Countries ..	3	101	129	172	164	218	197
Total Foreign Countries	13	86	118	125	188	148	144
Total All Countries ..	16	187	247	297	352	366	341
Re-exports	—	2	1	2	1	3	1
Net Imports	16	185	246	295	351	363	340

(a) Included in Other Empire Countries.

TABLE II.—Monthly Imports of Frozen Pork into the United Kingdom

Month.	1924.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	38	26	20	21	36	39	26
February	41	12	23	26	27	42	24
March	14	17	33	20	28	27	25
April	3	25	29	26	25	19	27
May	4	20	21	26	28	28	29
June	7	5	8	22	27	19	34
July	3	17	13	29	22	34	19
August	11	6	22	37	13	22	46
September	11	13	15	21	23	30	28
October	10	14	26	17	28	25	29
November	16	15	19	24	25	36	23
December	43	17	18	28	70	45	31
Total	201	187	247	297	352	366	341

Imports month by month from the principal sources in 1932 are given in Table III.

TABLE III.—*Monthly Imports of Frozen Pork into the United Kingdom during 1932*

Month.	New Zealand.	Australia.	United States of America and Argentina.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	6·8	6·9	10·4	1·6	25·7
February	9·0	6·8	6·2	2·1	24·1
March	11·9	1·7	10·8	0·4	24·8
April	13·0	4·1	8·5	1·2	26·8
May	13·6	3·4	9·0	2·5	28·5
June	15·0	5·3	9·1	4·4	33·8
July	7·5	3·7	6·8	1·3	19·3
August	13·9	5·4	26·2	0·8	46·3
September	13·1	4·0	10·1	0·8	28·0
October	12·1	1·2	14·9	0·9	29·1
November	5·7	1·5	12·8	2·9	22·9
December	9·5	1·5	16·7	3·6	31·3
Total	131·1	45·5	141·5	22·5	340·6

(ii) **Salted Pork**

Imports of salted pork into the United Kingdom averaged only 60,500 cwts. in the five years 1927–31, compared with a yearly average of 235,000 cwts. in 1909–13. Imports in 1932, at 34,209 cwts., were little more than half the 1931 figure.

Denmark is the principal source of imported salted pork, followed by the United States ; supplies from both countries were substantially reduced in 1932. Larger quantities were received from other countries, details of which are not available. Empire supplies, as a rule, are negligible.

There is a fairly appreciable re-export trade in salted pork, particularly to the Irish Free State, and this had developed considerably up to 1931. Re-exports in 1932, however, were 37 per cent. less than in the previous year, but were equal to very nearly half of the gross imports.

Details of the imports of salted pork in 1913 and 1927 to 1932 are given in Table I.

TABLE I.—*Imports of Salted Pork into the United Kingdom*

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Canada	(a)	1.4	0.9	0.7	0.1	0.2	(a)
Denmark	187.5	33.0	29.4	45.3	61.8	47.2	20.1
United States of America	42.3	10.8	10.6	11.4	17.0	14.8	6.8
Argentina	(a)	—	—	1.2	3.6	2.9	(a)
Other Countries	10.8	1.8	1.4	3.2	2.4	1.8	7.3
Total	240.6	47.0	42.3	61.8	84.9	66.9	34.2
<i>Re-exports</i>	<i>7.2</i>	<i>4.3</i>	<i>4.3</i>	<i>14.1</i>	<i>19.6</i>	<i>26.3</i>	<i>16.5</i>
Net Imports	233.4	42.7	38.0	47.7	65.3	40.6	17.7

(a) Included in Other Countries.

TABLE II.—*Monthly Imports of Salted Pork into the United Kingdom*

Month.	1924.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	2.4	4.8	2.3	2.1	2.6	5.7	4.1
February	2.7	5.8	4.9	5.1	6.4	7.3	5.8
March	2.3	4.2	6.7	5.1	6.8	5.3	4.6
April	1.3	3.4	3.3	4.5	7.9	3.7	3.7
May	7.2	4.1	4.0	7.5	8.5	7.0	2.9
June	3.8	2.9	4.4	6.7	8.0	7.0	2.7
July	4.2	8.8	3.5	5.7	9.1	6.2	2.8
August	3.0	6.1	5.0	8.1	9.1	5.2	1.3
September	3.6	2.8	1.1	6.9	8.4	5.7	1.5
October	3.5	2.8	2.7	5.9	8.6	4.5	1.8
November	1.8	0.7	2.6	3.7	4.3	5.4	1.4
December	1.9	0.6	1.8	0.5	5.2	3.9	1.6
Total	37.7	47.0	42.3	61.8	84.9	66.9	34.2

There is no pronounced seasonal fluctuation in supplies of salted pork, but imports in the second half of 1932 were much smaller than in the first six months. Throughout the twelve months the rate of importation was below the previous year's level, the reduction being much more marked in the second half of the year. At that period the bulk of the imports was from countries other than Denmark and U.S.A.

Monthly imports in recent years are shown in Table II.

Table III gives details of the monthly imports of salted pork from the principal sources during 1932.

TABLE III.—*Monthly Imports of Salted Pork into the United Kingdom during 1932*

Month.	Denmark.	United States of America.	Other Countries.	Total.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	3·2	0·7	0·2	4·1
February	4·2	1·4	0·2	5·8
March	3·1	1·1	0·4	4·6
April	2·6	1·0	0·1	3·7
May	1·8	0·7	0·4	2·9
June	2·1	0·1	0·5	2·7
July.. .. .	1·6	0·7	0·5	2·8
August	0·9	0·1	0·3	1·3
September	0·1	0·2	1·2	1·5
October	0·3	0·3	1·2	1·8
November	0·1	0·3	1·0	1·4
December	0·1	0·2	1·3	1·6
Total	20·1	6·8	7·3	34·2

IMPORTS OF LIVE PIGS

In addition to the trade in fresh and cured pig products there is a considerable annual importation into the United Kingdom of live pigs intended for food, all from the Irish Free State. The United Kingdom Trade Returns do not differentiate between fat and store pigs, but statistics of exports from the Irish Free State indicate that in the five years 1927 to 1931 fat pigs accounted for 84 per cent. of

total live pig exports by number, the remainder being store pigs. Practically all the fat pigs are sent to Great Britain, while most of the store pigs are consigned to Northern Ireland for further feeding. Of the total exports of live pigs in the period 1927-31, 83 per cent. were shipped to Great Britain and the remainder to Northern Ireland.

Imports of live pigs into the United Kingdom reached a maximum of 479,000 in 1931 but the number imported in 1932, totalling 303,000, was 37 per cent. less than in the previous year and the smallest since 1926.

Imports are at their maximum from October to March and particularly in the last three months of the year. The level of importation in 1932 was below that of a year earlier in every month except June. Only a slight upward movement occurred in the last quarter, in which period imports were less than one-half of the corresponding 1931 figures.

The following table shows the monthly imports of live pigs for food into the United Kingdom in the six years 1927 to 1932, all of the imports being from the Irish Free State.

Monthly Imports of Live Pigs (for food) from the Irish Free State

Month.	1927.	1928.	1929.	1930.	1931.	1932.
	000's.	000's.	000's.	000's.	000's.	000's.
January	31	39	29	35	43	34
February	27	24	29	36	42	34
March	34	31	32	30	41	31
April	28	26	17	26	34	26
May	23	21	22	30	30	25
June	28	20	19	20	18	25
July	30	17	13	25	29	20
August	27	20	17	33	33	16
September	37	29	25	40	45	15
October	42	28	35	43	50	27
November	40	29	36	48	56	29
December	48	34	37	49	58	21
Total	395	318	311	415	479	303

IMPORTS OF LARD

More than one-third of the total quantity of lard entering world trade is imported into the United Kingdom. Imports tend to fluctuate within comparatively narrow limits and the quantity imported in 1932, although only 5 per cent. less than in 1931 and 8 per cent. below the record 1929 figure, was the smallest since 1927.

The factory production of lard in the United Kingdom during 1924, the latest year for which complete figures are available, amounted to 670,000 cwts. The production in 1930 by bacon-curing and similar firms employing more than ten persons totalled only 133,000 cwts., compared with 365,000 cwts. in similar factories during 1924. As the output of home-produced bacon increased during this period it is difficult to account for such a marked decline in lard production, but the increased production of other by-products may be a factor and there has also probably been an improvement in the type of pig bred for bacon production. The Reorganisation Commission for Pigs and Pig Products estimated that lard production in the United Kingdom in 1930 was probably not less than half a million cwts., but if production by small butchers be added the actual figure is probably appreciably in excess of this estimate.

The United States of America is by far the principal source of imported lard on the United Kingdom market, supplying an average of about 85 per cent. of total imports in the past five years. The proportion was less than this in 1931, but increased quantities were received in 1932 and 87 per cent. of gross imports were of United States origin. Imports from all other sources were smaller than in 1931. Imports from Canada, the second largest source, were reduced by 46 per cent. and were below the level of other recent years. There was a fairly substantial reduction in supplies from Denmark and the Netherlands, and a slight decrease in imports from the Irish Free State, which have been declining over a period of years. Imports from Argentina, which increased substantially in 1931, suffered a material decline in 1932.

Empire supplies accounted for only 6 per cent. of total imports, compared with 11 per cent. in 1931.

Exports of imported lard in 1932 amounted to 5,760 cwts., compared with 8,480 cwts. in 1931. Exports of lard of United Kingdom manufacture totalled 3,440 cwts. in 1932, as compared with 5,760 cwts. in 1931.

TABLE I.—Imports of Lard into the United Kingdom

Country whence consigned.	1913.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Canada	83.1	250.7	233.8	242.3	168.3	209.0	113.6
Irish Free State ..	(a)	49.2	45.7	39.2	33.4	32.9	31.1
Other Empire Countries	1.4	0.2	1.9	3.4	11.1	30.0	11.3
Denmark	17.5	69.9	59.0	34.7	45.2	83.4	75.7
Netherlands	28.8	35.9	35.9	27.0	35.8	61.3	43.4
United States of America	1,869.0	1,966.9	2,056.3	2,258.1	2,172.5	2,065.1	2,104.2
Argentina	—	18.9	7.0	10.2	8.0	48.2	30.1
Other Foreign Countries	5.5	5.3	7.2	6.1	30.7	18.8	10.6
Total Empire Countries	84.5	300.1	281.4	284.9	212.8	271.9	156.0
Total Foreign Countries	1,920.8	2,096.9	2,165.4	2,336.1	2,292.2	2,276.8	2,264.0
Total	2,005.3	2,397.0	2,446.8	2,621.0	2,505.0	2,548.7	2,420.0
Re-exports	304.8	8.6	14.0	7.7	10.0	8.5	5.8
Net Imports	1,700.5	2,388.4	2,432.8	2,613.3	2,495.0	2,540.2	2,414.2

(a) Not separately recorded before 1st April, 1923.

TABLE II.—Monthly Imports of Lard into the United Kingdom

Month.	1930.		1931.		1932.	
	From United States of America	Total Imports.	From United States of America	Total Imports.	From United States of America	Total Imports.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	220.0	246.1	170.5	191.6	228.8	251.7
February	198.6	224.9	247.5	290.8	297.2	333.2
March	207.3	221.5	220.4	237.7	206.6	279.0
April	150.6	162.7	199.1	225.7	84.9	105.4
May	165.7	185.5	165.3	210.4	160.3	183.6
June	141.0	188.2	186.8	246.3	204.0	231.2
July	246.8	283.9	193.8	254.8	177.2	198.4
August	152.9	182.4	169.8	223.2	120.5	147.1
September	89.5	115.9	109.4	152.0	139.5	165.7
October	178.0	204.4	115.0	154.7	161.6	176.8
November	216.2	247.8	129.1	171.7	175.1	190.2
December	205.9	241.7	158.4	189.8	148.5	157.7
Total	2,172.5	2,505.0	2,065.1	2,548.7	2,104.2	2,420.0

Details of the imports of lard into the United Kingdom in 1913 and the six years 1927 to 1932 are given in Table I, while Table II shows total imports and imports from the United States month by month throughout 1930, 1931 and 1932. The substantial increase over the previous year's figures in the first quarter of 1932 and in the three months September to November was due to increased arrivals from the United States.

Prices of imported lard moved below the previous year's level in the first half of 1932, but tended to exceed the 1931 prices in the second six months. For the year as a whole, American lard was about 6 per cent. lower than in 1931, Danish showing a rather greater decline; between 1930 and 1931 the average price decline was some 16 to 18 per cent.

Table III shows average monthly prices of a few representative types of imported lard. The figures are from the weekly quotations of the London Provision Exchange and represent the average of top prices.

TABLE III.—Average Monthly Prices of Lard at London

Month.	Irish.				Danish.		American.	
	Bladders.		28-lb. boxes.		28-lb. boxes.		56-lb. boxes.	
	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.
	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.	Per cwt.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
January ..	75 3	80 0	45 9	49 3	44 9	48 6	47 3	50 6
February ..	80 0	78 0	45 0	45 0	44 9	44 6	47 0	47 0
March ..	80 0	74 0	44 6	48 0	40 6	46 9	44 9	52 0
April ..	74 6	76 0	—	46 6	37 3	45 0	41 3	49 3
May ..	70 0	72 9	—	44 0	35 6	42 3	38 9	45 0
June ..	68 0	70 6	35 9	42 3	32 0	42 3	38 0	45 6
July ..	68 0	69 6	46 0	41 0	43 0	40 3	46 9	45 0
August ..	68 0	66 0	—	—	42 0	39 0	49 6	42 9
September ..	67 3	66 0	47 0	42 0	43 3	41 6	49 9	47 9
October ..	66 0	68 6	—	53 3	42 6	50 0	48 6	56 0
November ..	72 0	70 0	51 0	50 9	45 9	47 9	52 9	51 6
December ..	74 0	70 0	46 9	52 9	—	51 0	47 0	54 0

SHIPMENTS OF BUTTER AND CHEESE FROM NEW ZEALAND AND AUSTRALIA

(i) New Zealand.

The past half century has witnessed a steady growth in butter production in New Zealand, and the rate of increase has been fully maintained in recent years. Gradings have shown a continuous expansion since the 1925-26 season and the quantity graded in the 1931-32 season (August to July) established a further record, exceeding the previous season's record by over 7 per cent. Compared with only five years earlier gradings show an increase of 32,500 tons, or 45 per cent. The current season's output has already achieved new records, the quantity graded from August, 1932 to April, 1933, being 22 per cent. greater than in the same period a year earlier and more than in any previous complete season.

Cheese production, as measured by gradings, has also increased, although the upward movement has been less marked and less regular than in the case of butter. Gradings in the 1931-32 season were slightly (about 1 per cent.) below those of the previous season, but available figures show that the current season has already established new records and the increase in the first nine months, compared with a year earlier, amounted to 14 per cent.

Gradings of butter and cheese in New Zealand during the past eight seasons and in the first nine months of the present season are given in Table I. Of the butter graded in the 1931-32 season, 96 per cent. was salted and 4 per cent. unsalted; two-thirds of the cheese were white and one-third coloured, the latter showing a slight increase compared with the previous season.

TABLE I.—*Gradings of Butter and Cheese in New Zealand*

Season.	Butter.	Cheese.
	Tons.	Tons.
1924-25	70,126	69,993
1925-26	62,557	74,145
1926-27	71,695	76,312
1927-28	74,723	75,753
1928-29	81,656	86,605
1929-30	95,343	87,252
1930-31	97,031	89,229
1931-32	104,211	88,194
1932-33 (August to April)	117,719	90,944

The bulk of the butter exported from New Zealand is shipped to the United Kingdom, which took nearly 99 per cent. of the total in the past season. Up to 1930 there had been a growing trade with Canada, but increased tariff rates and increased Canadian production caused a drastic decline in shipments to that country in the two following years. Supplies are mainly handled at London, but direct shipments to West Coast ports have increased appreciably within the past few years and comprised 18 per cent. of the total exports to the United Kingdom in 1931-32, compared with 11 per cent. in the 1930-31 season.

Shipments of butter to the principal destinations during each of the past six seasons are given in Table II.

TABLE II.—*Shipments of Butter from New Zealand (August to July)*

Destination.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
London	55,074	55,350	60,009	64,815	80,480	79,093
U.K. West Coast Ports ..	5,979	5,224	3,835	5,410	9,883	17,892
Vancouver	1,721	3,863	4,558	4,861	1,413	2
Halifax	936	2,601	7,693	15,668	75	—
Other	5,958	4,519	1,729	1,633	1,373	1,245
Total	69,668	71,557	77,824	92,387	93,224	98,232

Practically the whole of the exports of New Zealand cheese are shipped to the United Kingdom. London takes the bulk, but shipments to that port have fallen off in the past two seasons, as a result of larger quantities being sent to West Coast ports, which accounted for 21 per cent. of the total in 1931-32 against 15 per cent. in the previous season.

Table III shows the shipments of cheese during the past six seasons.

TABLE III.—*Shipments of Cheese from New Zealand (August to July)*

Destination.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
London	67,859	63,997	69,595	75,711	72,471	65,967
U.K. West Coast Ports ..	8,450	9,706	12,232	9,855	13,324	17,755
Other	529	703	663	254	67	71
Total	76,838	74,406	82,490	85,820	85,862	83,793

In the remaining five months of 1932 exports of butter were 22 per cent. greater than in the same period of 1931, shipments to West Coast ports again showing a relatively greater increase. Total exports of cheese in this period were 15 per cent. greater than a year previously, but direct shipments to ports other than London were below the previous year's level.

Details of the distribution of butter and cheese shipments in the five months August to December, 1932, are given in Table IV, with comparative figures for 1931.

TABLE IV.—*Shipments of Butter and Cheese from New Zealand (August to December)*

Destination.	Butter.		Cheese.	
	1st Aug., 1932 to 31st Dec., 1932.	1st Aug., 1931 to 31st Dec., 1931.	1st Aug., 1932 to 31st Dec., 1932.	1st Aug., 1931 to 31st Dec., 1931.
	Tons.	Tons.	Tons.	Tons.
London	42,058	35,656	29,274	23,620
U.K. West Coast Ports ..	9,104	6,432	4,405	5,597
Canada	259	13	—	—
Other	504	409	47	30
Total	51,925	42,510	33,726	29,247

(ii) **Australia**

Weather conditions, by their effect on pastures, play an important part in determining the course of dairy produce production in Australia, and exports are consequently subject to greater annual variation than in the case of New Zealand. Favourable conditions have combined with other factors, including exchange differences, the effective operation of the Paterson Plan and the relatively more remunerative returns from dairy farming compared with certain other branches of agriculture, to produce a phenomenal increase in butter production in the past two seasons. This has been reflected in

exports, which in the 1931-32 season (July to June) exceeded the previous season's record figure by 23 per cent. and were more than double the average of the previous five seasons.

Exports of cheese are of much less importance, and the 1931-32 figure was slightly under the previous season's total.

Table V below shows the trend of exports of butter and cheese from Australia during recent years.

TABLE V.—*Exports of Butter and Cheese from Australia (July to June)*

Season.	Butter.	Cheese.
	Tons.	Tons.
1924-25	63,937	5,123
1925-26	43,405	3,335
1926-27	34,004	1,768
1927-28	44,306	3,298
1928-29	45,821	3,938
1929-30	48,091	1,659
1930-31	73,951	4,220
1931-32	91,086	3,378
1932-33 (July to February)	77,923	4,101

The greater part of the exports of butter is shipped to the United Kingdom, which took 92 per cent. of the total in the 1931-32 season. Shipments to various Eastern ports account for the bulk of the remainder; supplies to Canada, which had been increasing, declined considerably last season. Smaller quantities are exported direct to other destinations, including India and European countries. Details of the distribution of the exports in recent years are given in Table VI.

TABLE VI.—*Distribution of Shipments of Butter from Australia (July to June)*

Destination.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
United Kingdom ..	28,217	38,138	39,237	41,079	66,169	83,973
Eastern Ports ..	4,299	4,783	4,927	5,521	5,106	5,820
Canada	12	214	173	515	1,226	206
Other	1,476	1,171	1,484	976	1,450	1,087
Total	34,004	44,306	45,821	48,091	73,951	91,086

The bulk of the cheese exported is consigned to the United Kingdom, which took 89 per cent. of the total in the 1931-32 season, the remainder being shipped to various Eastern ports and India.

Shipments of butter to the United Kingdom increased during the 1931-32 season from all States except Tasmania. The relatively large increase in the quantity shipped from Victoria in recent years enabled that State to displace Queensland from first place last season. An additional feature was the appearance of Western Australia as an exporter.

Most of the cheese exported from Australia is of Queensland origin, but there was an increase in shipments from other States in the 1931-32 season. Exports to the United Kingdom were as follows :—Queensland, 1,853 tons ; Victoria, 728 ; South Australia, 425 ; Tasmania, 11.

The large increase in production was continued during the current (1932-33) season, and exports of butter in the first eight months (July, 1932 to February, 1933) were 20 per cent. greater than a year earlier. Figures of shipments to the United Kingdom up to the end of March, 1933, indicate that the increase was greatest in exports from Victoria, but that all States shared in the advance.

Table VII gives details of shipments of butter to the United Kingdom from each State of the Commonwealth during the past six seasons.

TABLE VII.—*Shipments of Australian Butter to United Kingdom from various States (July to June)*

State.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Victoria	11,347	10,164	13,496	12,473	21,746	31,780
Queensland	9,496	19,436	19,301	20,185	30,035	30,807
New South Wales..	6,065	7,436	5,002	6,775	11,196	15,553
South Australia ..	718	279	255	294	1,088	3,335
Tasmania	591	823	1,183	1,352	2,104	1,873
Western Australia	—	—	—	—	—	625
Total to U.K.	28,217	38,138	39,237	41,079	66,169	83,973

Table VIII shows the shipments of butter from Australia to the United Kingdom in the first part of the 1932-33 season, with approximately comparative totals for 1931-32.

TABLE VIII.—*Shipments of Australian Butter to United Kingdom, 1st July, 1932 to 31st March, 1933*

State.	Period, 1st July, 1932, to 31st March, 1933.	<i>Period, 1st July 1931, to 26th March, 1932.</i>
	<i>Tons.</i>	<i>Tons.</i>
Victoria	35,945	25,363
Queensland	25,837	23,547
New South Wales	15,846	13,419
South Australia	3,850	2,764
Tasmania	1,657	1,343
Western Australia	1,007	635
	84,142	67,071

CANADIAN CHEESE PRODUCTION AND TRADE

The manufacture of factory cheese in Canada reached its peak about the beginning of the present century. Since then the tendency has been downwards, as is shown by the following figures of production of factory cheese at ten-yearly intervals. The production of farm cheese is negligible.

<i>Year.</i>	<i>Production.</i>
	<i>Cwts.</i>
1900	1,971,700
1910	1,784,900
1920	1,382,200
1930	1,063,400

The decrease has been accompanied by an increased production of creamery butter.

Since 1923 grading of cheese has been compulsory and grading figures in subsequent years reflect changes in production. The downward trend in gradings since 1925 was arrested in 1932, when the quantity graded was 7½ per cent. greater than in 1931 and the largest since 1928. Details of cheese gradings from 1924 to 1932 are given in the following table.

Gradings of Cheese in Canada

Year.	Boxes Graded.	Year.	Boxes Graded.
1924	1,584,359	1929	1,273,874
1925	1,895,112	1930	1,267,609
1926	1,845,581	1931	1,205,113
1927	1,472,333	1932	1,296,444
1928	1,567,182		

Details by Provinces indicate that increased quantities were graded in 1932 in each Province except British Columbia. Ontario accounted for 73 per cent. of the gradings in the Dominion as a whole, but the increase over 1931 was relatively more marked in the case of Quebec, where it amounted to 18 per cent. Details of cheese gradings by Provinces in the four years 1929 to 1932 are given in the following table:—

Cheese Gradings by Provinces

Province.	1929.	1930.	1931.	1932.
	Boxes.	Boxes.	Boxes.	Boxes.
P.E.I.	15,378	8,998	5,287	8,378
N.B.	489	203	286	383
Quebec	381,763	367,220	280,794	330,301
Ontario	875,022	888,955	909,638	950,981
Manitoba	1,222	2,163	1,436	2,239
Saskatchewan	—	70	—	1,877
Alberta	—	—	—	59
British Columbia	—	—	7,672	2,226
Total	1,273,874	1,267,609	1,205,113	1,296,444

The greater part of the cheese produced in Canada is intended for export, and this trade has broadly reflected the trend of production, being at a maximum in the first decade of the present century. The tendency has been downwards in recent years, but an increase in 1931 was followed by a further slight increase, equal to under 3 per cent. in 1932. Exports during recent calendar years have been as follows:—

Exports of Cheese from Canada

Year.	Exports.	Year.	Exports.
	cwts.		cwts.
1925	1,345,919	1929	829,876
1926	1,202,286	1930	715,747
1927	986,902	1931	757,039
1928	1,019,219	1932	776,249

The bulk of the cheese is shipped from Montreal, but heavier quantities were shipped from Quebec last season. Total exports of cheese from Quebec in 1932 amounted to 68,370 cwts., compared with 28,374 cwts. in 1931.

The United Kingdom is by far the principal market for Canadian cheese. Exports to this country increased by 4 per cent. in 1932, while the small supplies to the United States declined further. Details of the exports in the three years 1930 to 1932 are as follows:—

Destination.	1930.	1931.	1932.
	cwts.	cwts.	cwts.
United Kingdom	663,042	719,335	748,338
U.S.A.	29,365	14,155	5,447
Other Countries	23,340	23,549	22,464
Total	715,747	757,039	776,249

The proportionate distribution of shipments to the United Kingdom and Irish Free State in the 1932 season was as follows:—To London, 53 per cent. ; to Liverpool, 10 per cent. ; to Bristol, 10 per cent. ; to Manchester, 7 per cent. ; to South Wales ports, 5 per cent. ; to Scottish East Coast ports, 5 per cent. ; to Glasgow, 4 per cent. ; to English East Coast ports, 4 per cent. ; to Irish ports, 2 per cent.

THE 1932-33 SEASON FOR AUSTRALIAN AND SOUTH AFRICAN EGGS

(i) Australian

The export trade in eggs from Australia has shown a marked development in recent years, new records having been established in each year since 1927. Exports during the 1932-33 season, according to preliminary figures, were over 70 per cent. greater than in the previous season, following an increase of 70 per cent. between 1930-31 and 1931-32. The different States contributed to the exports in the following proportion:—New South Wales, 36 per cent.; South Australia, 24 per cent.; Victoria, 23 per cent.; Western Australia, 9 per cent.; Queensland, 8 per cent. The figures for Victoria include considerable quantities of Tasmanian eggs.

Practically all the exports of eggs are shipped to the United Kingdom and arrivals during the past season totalled 1,682,000 great hundreds, compared with 981,000 great hundreds in the preceding season. Arrivals were spread over 31 weeks, compared with 22 weeks last season, but excluding the late arrivals in March, 1933, regular shipments were spread over 26 weeks. November was the month of heaviest arrivals, whereas in the previous year supplies had been greatest in December. The bulk of the supplies was handled at London, but there was an increase in direct shipments to other ports. Direct shipments were approximately as follows, with figures for the previous season in brackets:—London, 1,470,000 great hundreds (843,500); Liverpool, 126,000 (65,000); Hull, 48,000 (30,000); Glasgow, 37,200 (42,400); Manchester, 564 (—).

Over the season as a whole average prices were very slightly less than in the previous season. Early in the season prices were on a higher level than a year earlier, but when supplies were at their height in November prices were appreciably under the corresponding 1931 figures. As a result of the steady demand and short supplies throughout January, prices again exceeded those of a year previously. For the season as a whole, excluding the seasonally reduced quotations for one week in March, the average price for the 16 lb. description was about 13s. 1½d. per 120 and for the 15 lb. pack 12s. 8d., as against 13s. 7d. and 12s. 8d. respectively in the 1931-32 season.

The following table shows total monthly arrivals of Australian eggs in the United Kingdom, according to the Board's figures, and average prices for two representative grades. It should be noted

that these figures, which represent the average of top quotations on the London Egg Exchange, do not necessarily reflect a figure at which the maximum volume of sales took place, but are merely given to afford an appropriate basis of comparison between the two seasons, and between different periods of the same season.

TABLE I.—*Supplies and Prices of Australian Eggs*

Month.	1931-32.			1932-33.		
	Arrivals.	Prices.		Arrivals.	Prices.	
		16 lb.	15 lb.		16 lb.	15 lb.
	Gt. hds.	Per 120. s. d.	Per 120. s. d.	Gt. hds.	Per 120. s. d.	Per 120. s. d.
August	—	—	—	11,400	—	—
September	14,019	—	—	91,845	13 2	12 9
October	180,549	12 8	12 4	250,024	13 8	13 2
November	238,476	15 8	14 10	527,980	13 9	13 3
December	390,543	13 2	12 8	414,851	13 0	12 9
January	157,416	12 5	12 1	281,998	12 2	11 8
February	—	—	—	80,661	13 0†	12 7†
March	—	—	—	23,247	7 0*	—

* One week's quotation.

† Two weeks' quotation.

(ii) **South Africa**

The export trade in South African eggs reached its peak in the 1930-31 season, when a total of 578,000 great hundreds was shipped overseas. A slight decline was experienced in the following season and a further decrease, equal to 6 per cent., occurred in the 1932-33 season. The different producing areas contributed to the exports in the following proportions :—Western Province, 36 per cent. ; Transvaal, 26 per cent. ; Natal, 12 per cent. ; Port Elizabeth, 10 per cent. ; East London, 10 per cent. ; Orange Free State, 5 per cent. ; Rhodesia, 1 per cent. The greater part of the egg production of the Orange Free State is marketed in the other provinces and included in the export figures of the latter.

Shipments of eggs from South Africa to the United Kingdom during the 1932-33 season, totalling 528,000 great hundreds, were 6 per cent. smaller than in the previous season and 8 per cent. below the record 1930-31 shipments. Arrivals commenced in the third week of September and were spread over 19 weeks, beginning and ending one week later than in the previous season. For a period of five weeks from the middle of November the quantities arriving were greater than a year earlier, but during the remainder of the season shipments were generally below the previous season's level. Weekly arrivals reached their peak in the first week of November, or about a fortnight later than in the 1931-32 season.

Prices in October and during the second half of December were slightly above the previous year's level, but during the remainder of the period last season's prices were not attained, the reduction being most marked in November, when supplies were at their height. For the season as a whole, the 16 lb. pack averaged 13s. 7d. per 120 and the 15 lb. pack 13s. 2d., compared with 14s. 1½d. and 13s. 7½d. respectively in the previous season.

The following table shows the monthly arrivals of South African eggs, and average prices of two representative grades. The reservations attaching to the preceding table apply with equal force to the following :—

TABLE II.—*Supplies and Prices of South African Eggs*

Month.	1931-32.			1932-33.		
	Arrivals.	Prices.		Arrivals.	Prices.	
		16 lb.	15 lb.		16 lb.	15 lb.
	Gt. hds.	Per 120. s. d.	Per 120. s. d.	Gt. hds.	Per 120. s. d.	Per 120. s. d.
September	53,283	13 7½*	13 7*	37,743	13 6*	13 2*
October	179,424	13 1	12 8	193,314	13 10	13 6
November	196,104	15 11	15 4	162,153	14 5	13 11
December	106,263	13 10½	13 5	105,906	13 10	13 4
January	28,392	13 2	12 10	29,211	12 4	11 11

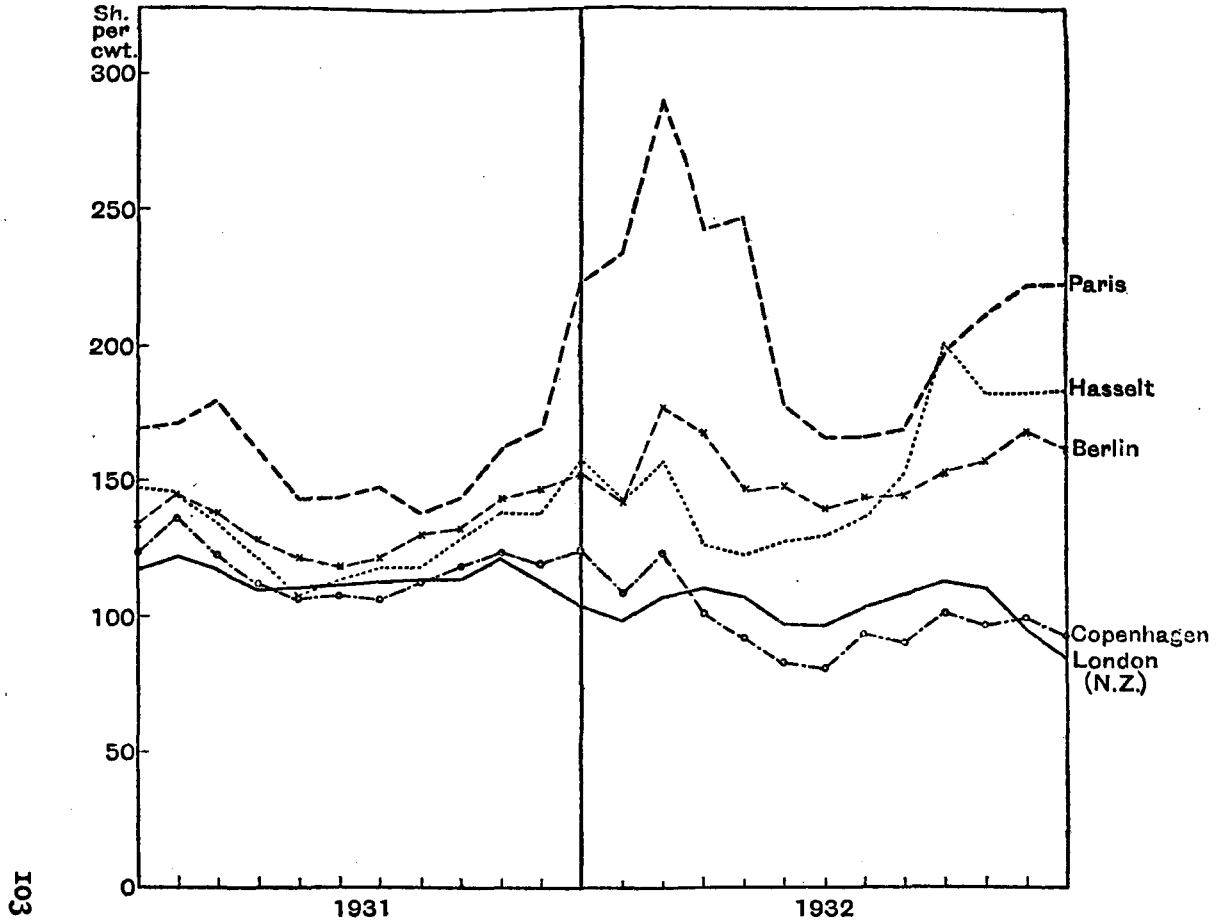
* Two weeks' quotations.

THE BUTTER MARKET IN EUROPEAN IMPORTING COUNTRIES IN 1932

The expansion of the dairy industry within the past decade, resulting from the steady growth of countries like Denmark and the more spectacular advance of the Baltic Secession States and the countries of the Southern Hemisphere, has meant an increasing volume of butter being directed into the channels of international trade. The product of a well-organised industry, as in most exporting countries, it began to find an increasing outlet in countries other than the United Kingdom, where the home industries in many cases were comparatively unorganised. The growing imports, which have coincided with falling prices in the last few years, began to be viewed with alarm by countries which, like France, had a large home industry and figured as a net exporter until comparatively recently, or, like Germany, desired to become more self-supporting. Legislative measures, often drastic, were adopted and the quota method of control came into operation. The departure of the United Kingdom from the gold standard, accompanied by the depreciation in the currencies of countries, such as Denmark, Sweden and the Southern Dominions, normally large exporters of dairy produce, accentuated the difficulties in importing countries and hastened the adoption of restrictive measures. By 1932 the control of imported dairy produce by quota, in one form or another, was in operation in all the principal European importing countries.

In the following section a short résumé is given of the measures adopted by the chief European importing countries to restrict the imports of butter. Their effect on the actual quantities imported can be seen in the tables accompanying the discussion of imports (pp. 111 to 121). The effect on prices is more difficult to gauge, due to a variety of factors, but the restrictions have been followed, in many cases, by significant price changes. The accompanying table compares the price of a representative butter at Berlin, Paris and Hasselt (Belgium) with New Zealand butter at London and with the Copenhagen quotation for Danish butter, monthly throughout 1931 and 1932. The quotations are also given on a sterling basis. It is not suggested that the descriptions are similar, but the table does provide a broad basis of comparison and also indicates the extent of the movement on each market in the two years. The variation in these descriptions is also seen, translated to their sterling equivalent, in Figure 6 on page 103.

FIG 6. BUTTER PRICES AT CERTAIN MARKETS, 1931 AND 1932.
 (in shillings per cwt. at Prevailing Rate of Exchange).



Average Monthly Price of Butter at certain European Markets

Month.	London (New Zealand Finest Salted).		Copenhagen.		Berlin.		Paris (Charentes).		Hasselt.	
	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.
	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Kr. per 100 Kg.	Kr. per 100 Kg.	Rm. per 100 Kg.	Rm. per 100 Kg.	Fr. per 100 Kg.	Fr. per 100 Kg.	Fr. per 100 Kg.	Fr. per 100 Kg.
January ..	99 6	117 0	195	220	201	270	2,016	2,069	1,732	2,525
February ..	106 9	121 9	230	243	251	291	2,480	2,087	1,910	2,481
March ..	110 0	118 3	180	222	249	277	2,207	2,200	1,611	2,320
April ..	106 9	110 9	167	200	226	254	2,312	1,995	1,625	2,099
May ..	97 0	110 6	149	192	224	244	1,647	1,770	1,671	1,867
June ..	97 6	112 0	146	193	212	241	1,519	1,770	1,675	1,954
July ..	104 3	113 6	170	190	213	248	1,493	1,790	1,727	2,004
August ..	109 3	114 3	166	201	209	262	1,486	1,681	1,889	2,030
September ..	113 9	114 6	192	210	220	250	1,710	1,639	2,475	2,060
October ..	110 3	121 0	184	213	222	237	1,792	1,574	2,194	1,888
November ..	94 6	113 0	187	209	229	224	1,822	1,577	2,118	1,815
December ..	84 6	103 6	178	222	219	213	1,849	1,880	2,146	1,877

Sterling equivalent at the average rate of exchange for each month.

	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.	Sh. per cwt. s. d.
January ..	99 6	117 0	109 0	122 9	141 0	134 3	234 6	169 9	142 9	147 3
February ..	106 9	121 9	123 0	136 0	175 3	144 9	287 0	171 0	158 6	144 9
March ..	110 0	118 3	100 9	124 0	165 9	138 3	243 6	180 0	125 9	135 3
April ..	106 9	110 9	93 3	111 9	145 6	126 3	246 9	163 0	123 3	122 0
May ..	97 0	110 6	83 0	107 6	147 9	121 3	179 6	144 6	127 6	109 0
June ..	97 6	112 0	81 0	107 9	140 0	119 3	166 6	144 9	130 0	113 9
July ..	104 3	113 6	93 3	106 3	144 6	120 3	167 6	146 9	137 0	117 0
August ..	109 3	114 3	90 0	112 6	145 0	130 0	170 0	137 9	153 0	113 3
September ..	113 9	114 6	101 0	118 6	153 6	131 3	196 0	144 3	200 9	128 6
October ..	110 3	121 0	96 9	122 9	157 9	143 9	210 0	161 6	182 6	138 0
November ..	94 6	113 0	99 0	119 6	168 9	145 6	221 6	169 3	182 6	138 0
December ..	84 6	103 6	93 6	124 9	161 6	152 0	223 9	222 6	184 3	157 6

Germany

Increased protection for the German butter industry was bound up with the Finnish German Treaty, which specified a lower tariff rate of 27.50 Reich Marks per 100 kg. An amended Treaty raised the rate, as from 27th November, 1930, to 50 R.M. On 1st December, 1931, a quota was instituted, and came into force on 23rd January, 1932, by a further agreement with Finland, which permitted

that country to export 5,000 tons of butter to Germany at the conventional rate, a quantity about equal to Finland's normal export to Germany. Supplies from all countries on a most favoured nation basis were automatically restricted to the same quantity at the lower rate. An Emergency Decree of 18th January, 1932, provided for the general raising of tariff rates and butter was brought within its provisions as from 23rd January. A surcharge on butter from countries with depreciated currencies was instituted and the final result was that six separate tariff rates on imported butter came into operation. Countries with which Germany had commercial treaties and which were on the gold standard paid 50 Reich Marks per 100 kg. for quantities within the quota and 100 Reich Marks for the remainder; countries having commercial treaties with Germany but which were off the gold standard paid 86 R.M. and 136 R.M. respectively; countries having no commercial treaties with Germany paid 170 R.M. per 100 kg. and Poland, as a result of a separate agreement, paid 100 R.M. The annual quota of 5,000 tons was put on a monthly basis as from 1st March, 1932, the maximum permissible quantity to be imported in any one month being 500 tons.

The application of the foregoing tariff-quota operated particularly against those countries which figured as important sources of supply, particularly Denmark and the Netherlands. On the other hand certain less important sources, as the Baltic countries, were enabled to ship as much butter as formerly, at the lower rate. Considerable dissatisfaction ensued which finally caused the tariff-quota to be dropped altogether. Instead, a flat rate of 75 R.M. per 100 kg. on imported butter was introduced as from 15th November, 1932, and at the same time total imports were limited to an annual quantity of 55,000 metric tons, the quota being divided among supplying countries in proportion to their average exports to Germany in the three years 1929 to 1931.

The effect of these various measures up to the end of 1932 was to reduce supplies of imported butter, as is shown in the table on page 112. The probable effect in 1933 will be to increase slightly imports from Denmark and possibly the Netherlands compared with 1932, at the expense of supplies from Baltic countries, which were more favourably situated in the latter year.

The effect on prices is more difficult to assess, due to the low level of internal purchasing power. The former relationship between home-produced butter prices and world market quotations was upset

in 1932, but the average price of home-produced butter at Berlin was 11 per cent. less than in 1931, following a decline of 10 per cent. between 1930 and 1931. The graph on page 103 shows that the margin between prices in Germany and in world markets increased during 1932. At the same time butter consumption has fallen off during the past two years, as is shown on page 111.

France

France has for long pursued a protectionist policy for agricultural products. In the case of butter the existing tariffs of 100 francs per 100 kg. (minimum) and 200 francs (general) were doubled in June, 1930, in an attempt to check the rapidly growing imports. Imports continued to increase (see page 118), and on 30th September, 1931, butter was brought within the scope of control by quota.

The quota thus instituted was a "global" one with no reference to individual countries. A rush of imports followed and the permissible quantity to be imported in the last quarter of 1931 was quickly exhausted. A system of individual quotas and control by licence was therefore inaugurated towards the end of the year. About the same time compensatory surtaxes were imposed on butter from countries with depreciated currencies.

A combination of circumstances early in 1932 caused butter prices to rise to exceedingly high levels and the quota was increased on two occasions in the first quarter of the year. On 28th September, 1932, the quota on butter was abolished altogether and, in its place, the minimum tariff was raised to 700 francs per 100 kg. and the general to 1,400 francs. On 17th February, 1933 a further increase to 850 francs "minimum" and 1,700 francs "general" occurred, the compensatory surtax being removed about the same time. Finally, on 9th March 1933, a quota was again introduced, the tariff rates remaining unaltered.

The effect of the quotas and tariffs was to reduce imports considerably in 1932, as is seen in Table I, page 118. The tables and diagram on pages 103 and 104 illustrate their effect on prices. In the spring and winter months, when importation normally takes place, prices in 1932 were considerably higher than in 1931, while a lower level was reached during the period of heavy home production. Throughout 1932 butter prices in France were higher than in any other major market.

Belgium

The tariff on butter imported into Belgium was merely nominal (20 francs per 100 kilograms) up to 1931. Imports increased at a rapid rate (see page 119) and when the Bill to raise tariff rates was introduced on 27th November, 1931, butter was brought within its scope as from that date, a coefficient of seven applied to the old rate, plus a surcharge of 15 per cent. bringing the rate to 161 francs per 100 kg. The increased duties were insufficient to curtail seriously the increasing imports and a quota was introduced on 26th April, 1932, importation being made subject to licence.

The effect of the quota was to reduce the quantity imported in the remaining months of 1932, compared with a year earlier. When the tariff was introduced, butter prices in Belgium varied with world prices and moved above them at a level approximately equal to the tariff. There was little significant difference for a short time after the introduction of the quota, as home production during the summer months is generally nearly sufficient for home requirements. When production fell off from late summer onwards, however, prices advanced considerably. The table on page 104 and Figure 6 on page 103 shows the course of prices of Belgian creamery butter at Hasselt, an important market, in 1931 and 1932, in comparison with prices in other countries.

Early in 1933 a bill to impose a special tax on import licences was introduced. Butter importers expressed willingness to submit to a voluntary tax before the bill became law and, in return, the quota on butter was increased for that month. By May, however, imports were on a small scale.

Switzerland

The price of milk in Switzerland is controlled by the price of cheese for export, and as cheese prices were on a higher level than butter, there was no incentive to increase butter production. The home industry was protected to some extent by tariffs, but these were insufficient to prevent a relatively large importation of butter. As from 12th August, 1929, the tariff on imported butter was raised from 20 francs to 70 francs per 100 kg. and numerous alterations to the rate followed in the three succeeding years. On 1st September, 1930, the rate was raised to 120 francs per 100 kg. and on 23rd December, 1931, to 180 francs. A temporary reduction to 150 francs on 22nd February, 1932, was followed by an increase to 180 francs on 20th March, 1932.

The Swiss cheese industry at this time was affected by reduced purchases by foreign countries and one reason for the upward revisions in the butter tariff was to encourage a change from cheese to butter production. State subsidies to prevent an undue drop in the price of milk had been granted on several previous occasions, and as from 1st April, 1932, imports of butter were subject to restriction by licence. The tariff rate was fixed at 120 francs, of which 50 francs were utilised as a fund to maintain prices to the producer. Importation was put in the hands of a Butter Control Board ("Butyra") which exercises monopoly control and is required to purchase the home butter output. Independent importers must pay a licence for imported butter equivalent to the difference between the Copenhagen Quotation and the internal price.

The effect of these measures has been to reduce imports considerably, as is seen in the table on page 120, and during certain months of 1932 no butter was imported. At the same time the output of milk has continually increased. As a result the funds for supplying the necessary credits fell short of anticipations and further measures had to be adopted. These included the granting of an additional 6 million francs and, in addition, considerably increased tariff rates were placed on imported feeding-stuffs, three-quarters of the extra rate being used to prolong the aid to milk producers. The latter measures came into force on 22nd December, 1932, and operated until 30th April, 1933.

Finally, a Federal Decree of 13th April, 1933, indicated the aid which was to be granted for the twelve months beginning 1st May, 1933, in order to maintain the price of milk to the producer at 18 centimes per kg. A sum of 20 million francs was put at the disposal of the Federal Council for this purpose, in addition to three-quarters of the additional duties on feeding-stuffs, and the proceeds of the supplementary tax on butter and profits of "Butyra". Of the foregoing credit 2 million francs and one-quarter of the additional duty on imported feeding-stuffs were to be used for other measures to alleviate the effect of the agricultural crisis, including the promotion of the sale or exportation of cattle. The importation of feeding-stuffs was to be placed under the control of an import board.

WORLD TRADE IN BUTTER AND CHEESE, 1931 AND 1932

The following table, published by the International Institute of Agriculture, shows the foreign trade in butter and cheese of the principal exporting and importing countries during 1931 and 1932.

	BUTTER.			
	Exports.		Imports.	
	1932. 000 lb.	1931. 000 lb.	1932. 000 lb.	1931. 000 lb.
<i>Exporting Countries :—</i>				
Austria	1,565	2,862	802	1,565
Denmark	347,886	378,429	922	1,596
Estonia	27,626	31,844	—	—
Irish Free State	36,932	42,307	2,632	3,325
Finland	32,020	38,367	—	—
Hungary	4,495	4,065	—	117
Latvia	41,000	41,313	2	24
Lithuania	21,883	19,191	—	—
Norway	2,421	1,629	90	379
Netherlands	44,926	72,660	9,323	8,887
Poland	2,707	27,470	866	31
Sweden	29,875	43,045	33	40
U.S.S.R.	68,198	68,024	—	—
Argentina	55,973	51,167	—	—
India	260	366	428	344
Syria and Lebanon	315	1,817	1,867	344
Australia	229,105	191,016	—	—
New Zealand	244,588	222,718	—	—
<i>Importing Countries :—</i>				
Germany	478	269	153,264	220,950
Belgium	1,841	2,756	46,778	41,562
Spain	44	88	42	121
France	7,921	11,045	26,140	40,836
Great Britain and Northern Ireland.	35,693	40,228	946,298	903,967
Greece	—	—	1,197	2,059
Italy	827	1,283	3,818	6,188
Switzerland	7	20	8,151	23,358
Czechoslovakia	26	661	2,703	4,107
Canada	3,505	10,681	238	2,822
United States	1,607	2,008	1,014	1,881
Ceylon	—	—	602	642
Java and Madura	—	—	8,516	8,514
Japan	—	—	163	231
Algeria	35	73	3,955	4,389
Egypt	364	77	765	2,041
Tunis	4	9	1,305	930
Total	1,244,127	1,307,488	1,221,914	1,281,250

	CHEESE.			
	Exports.		Imports.	
	1932. 000 lb.	1931. 000 lb.	1932. 000 lb.	1931. 000 lb.
<i>Exporting Countries :—</i>				
Bulgaria	2,601	3,133	4	4
Denmark	14,535	9,383	130	604
Finland	7,225	5,776	26	33
Italy	66,399	88,948	8,805	10,115
Lithuania	1,768	2,546	7	11
Norway	3,644	2,840	240	562
Netherlands	170,061	190,460	1,076	1,345
Poland	767	2,884	586	761
Switzerland	43,700	54,307	4,751	8,470
Czechoslovakia	6,124	10,981	3,071	3,779
Yugoslavia	2,617	4,198	150	243
Canada	86,940	84,790	1,166	1,446
Australia	8,803	7,412	60	24
New Zealand	163,980	183,271	2	4
<i>Importing Countries. :—</i>				
Germany	4,237	7,359	108,688	120,404
Austria	3,982	6,232	3,732	5,781
Belgium	553	814	45,660	49,600
Spain	238	236	2,480	3,867
Irish Free State	37	194	2,019	2,687
France	29,211	34,289	52,267	82,810
Great Britain and Northern Ireland.	7,242	7,346	336,733	323,091
Greece	620	190	1,753	3,960
Hungary	33	110	11	203
Portugal	—	—	608	842
Sweden	—	—	1,045	1,691
United States	1,534	1,863	55,632	61,992
India	2	4	939	886
Java and Madura	—	—	1,642	1,658
Syria and Lebanon	68	86	1,195	708
Algeria	159	172	11,100	11,182
Egypt	231	73	4,769	7,335
Tunis	13	24	2,191	2,033
Total	627,324	709,921	652,538	708,131

GERMANY

THE BUTTER MARKET IN 1932

Imports of butter into Germany, the largest market for foreign butter next to the United Kingdom, increased rapidly up to 1929. Efforts were made, by increased tariff rates in 1931 and by the institution of quota systems in 1932, to render the country rather more self-supporting for butter and these measures, combined with diminished purchasing power and exchange restrictions, have caused a sharp decline in imports during the past two years. Total imports in 1932, amounting to 1,368,486 cwts., were less than in 1931 by 604,400 cwts., or 31 per cent., and little more than half as heavy as in 1930.

Home production of butter in Germany is estimated to have accounted for about three-quarters of the total quantity consumed, but in 1932 the proportion rose to approximately 85 per cent. The production of milk is estimated to have shown little change compared with 1931, but consumption of liquid milk declined appreciably. Production of butter is estimated* to have increased from 374,000 tons in 1931 to 388,000 tons in 1932, but, taking into account the reduction in imports, consumption fell by about 3 per cent. The per capita consumption of butter in Germany in 1932 is estimated to have been about 15·7 lbs., compared with 16·2 lbs. in 1931, whereas margarine consumption is estimated to have risen from 16·1 lbs. per head in 1931 to 17·6 lbs. in 1932.

The following table gives the imports of butter into Germany in the past nine years :—

TABLE I.—*Imports of Butter into Germany, 1924–32*

Year.	Imports.	Year.	Imports.
	000 cwts.		000 cwts.
1924	1,052·7	1929	2,645·0
1925	1,901·8	1930	2,621·2
1926	1,925·0	1931	1,972·8
1927	2,130·4	1932	1,368·5
1928	2,491·1		

* Institut für Landwirtschaftliche Marktforschung.

The tariff-quota originally introduced in 1932 had a considerable effect on the quantities imported from individual sources compared with earlier years. The greatly increased tariff rates on supplies beyond a certain fixed quantity bore most heavily on those countries which were normally the largest sources of supply, particularly Denmark and the Netherlands, and imports from the former were reduced by considerably more than half. The revised system adopted in November, 1932, was rather more favourable to Denmark. An increase of 74 per cent. in imports from Russia enabled that country to displace Denmark as most important source of imported butter during the year. Smaller quantities were imported from Sweden and Latvia, but there was an increase in imports from Lithuania; imports from Poland were reduced to small dimensions. In spite of smaller Australian entries, larger quantities of Southern Hemisphere butter were imported, although these comprised an insignificant proportion of total imports.

Table II gives details of the imports of butter into Germany in the four years 1929 to 1932.

TABLE II.—*Imports of Butter into Germany*

Country whence consigned.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Russia	124·3	61·7	150·4	261·6
Denmark	866·2	865·4	603·1	260·7
Latvia	223·9	293·4	237·7	182·6
Netherlands	644·8	558·2	321·8	175·3
Estonia	135·9	177·7	122·6	118·2
Lithuania	79·6	112·3	84·1	109·8
Sweden	220·7	219·6	133·2	77·9
Finland	87·8	101·8	80·0	59·1
Australia	3·3	0·4	29·6	23·2
Hungary	9·1	20·4	17·9	19·7
New Zealand	0·3	10·5	2·0	18·0
Poland	200·3	141·4	141·4	16·0
Austria	9·9	28·7	24·7	11·9
Argentina	0·6	3·8	6·8	11·7
Belgium	15·1	12·1	9·3	3·4
Other Countries	23·2	13·8	8·2	19·4
Total	2645·0	2621·2	1972·8	1368·5

Seasonal Variation.—Imports into Germany tend to be greater in the second half of the year, unlike the United Kingdom imports, where the large proportion of Southern Hemisphere supplies makes imports heavier in the first half of the year.

Increased imports in anticipation of revised import restrictions brought the total in January, 1932, above the previous year's level, but in each subsequent month the rate of importation was much lower than in 1931, the disparity being particularly marked during the summer months.

Monthly imports of butter in each of the past four years are given in Table III.

TABLE III.—*Monthly Imports of Butter into Germany*

Month.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
January	273·3	221·4	152·8	169·2
February	197·3	157·4	152·7	113·1
March	183·2	172·5	136·0	118·7
April	164·3	189·9	142·9	86·1
May	211·2	208·2	172·1	110·6
June	204·7	210·4	159·5	96·5
July	236·4	294·8	178·0	75·4
August	262·4	236·5	168·0	103·2
September	253·0	244·5	165·3	139·3
October	245·6	261·8	192·3	120·3
November	218·5	233·3	171·2	123·0
December	195·1	190·5	182·0	113·1
Total	2,645·0	2,621·2	1,972·8	1,368·5

Prices.—Except for a period of seven weeks from early November, German butter prices in 1932 were consistently lower than in 1931. The weekly Berlin quotation for 1st quality home-produced butter averaged 111·5 R.M. per 50 kg., as compared with 125 R.M. in 1931. The highest point of 135 R.M. was reached in February and the lowest, of 95 R.M., in the last week of the year. (*See also* the table on page 104 and Figure 6, page 103.)

IMPORTS OF CHEESE

Imports of cheese into Germany have tended to decline in recent years. Following a decrease of 12 per cent. between 1930 and 1931, imports in 1932, totalling 970,465 cwts., were approximately 10 per cent. less than in 1931. Imports of hard cheese, however, declined by only 2½ per cent. and comprised 91 per cent. of the total, as compared with 85 per cent. in the previous year, whereas imports of soft cheese were reduced to one-half of the 1931 figure. The rates of duty upon imported cheese were bound up with a number of multi-lateral trade agreements and imports from most countries were at the minimum rates, but the lapse of some of these treaties early in 1933 was followed by increased duties combined with quotas at lower rates.

The production of hard cheese in Germany in 1932 is estimated to have declined by 2 per cent., and of soft cheese by 5 per cent., compared with 1931.

The Netherlands is the source of origin for two-thirds of the cheese imported into Germany, but imports from that country declined by 4 per cent. in 1932. Imports from Denmark, which fell off in 1931, increased by 45 per cent. in the past year, and heavier quantities were imported from Finland and Norway. Very considerable reductions occurred, however, in imports from Switzerland, Italy and Czecho-Slovakia, the two last-named countries shipping mainly soft cheese. Slightly larger quantities were imported from the United Kingdom, but these had declined substantially in 1931.

Table IV gives total imports of cheese into Germany since 1924, and in Table V imports in the four years 1929 to 1932 are analysed according to country of consignment.

TABLE IV.—Imports of Cheese into Germany

Year.	Imports.	Year.	Imports.
	000 cwts.		000 cwts.
1924	863·5	1929	1308·7
1925	1454·9	1930	1215·5
1926	1262·1	1931	1075·1
1927	1407·4	1932	970·5
1928	1210·2		

TABLE V.—Imports of Cheese into Germany

Country whence consigned.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Netherlands	804·4	761·6	669·3	640·7
Denmark	120·9	100·3	74·6	109·7
Finland	44·0	40·3	47·9	55·4
Czecho-Slovakia	11·4	29·4	53·0	30·0
Switzerland	133·8	108·8	52·2	24·0
Norway	0·9	2·3	15·0	22·4
Italy	26·3	38·8	54·9	16·5
Austria	14·4	19·5	21·1	14·2
United Kingdom	30·0	22·8	13·3	14·0
Poland	38·3	31·9	24·7	6·5
France	37·4	24·4	10·4	3·7
Other Countries	46·9	35·4	38·7	33·4
Total	1308·7	1215·5	1075·1	970·5

IMPORTS OF EGGS

Germany has figured as the largest importer of eggs next to the United Kingdom during recent years, and in 1932 the quantity imported almost equalled imports into the United Kingdom. Imports were under 2 per cent. larger than in 1931, although smaller than in any of the four preceding years. The increase was more pronounced in the second half of the year.

Between 1925 and 1930 there was a steady expansion in egg production in Germany, but this was not maintained in the two following years. The number of fowls declined slightly in 1932 and egg production is estimated* to have been about 50·5 million great hundreds (equal to 70 per cent. of total consumption) compared with 53 million great hundreds in 1931. The *per capita* consumption of eggs in Germany fell from about 134 in 1931 to 130 in 1932.

In April, 1933, the tariff on imported eggs was raised from 5 to 70 R.M. per 100 kg., amended in the following month by the German-Netherlands Agreement to 40 R.M. (30 R.M. in winter) for 60 per cent. of the imports from each country in the period, May to December, 1932; a considerable decline in imports during 1933 is, therefore, to be anticipated.

Imports of eggs from 1924 to 1932 are given in Table VI.

TABLE VI.—*Imports of Eggs into Germany*

Year.			Imports.	Year.			Imports.
			Gt. hds. 000				Gt. hds. 000
1924	..	..	10,447	1929	..	..	22,941
1925	..	..	20,305	1930	..	..	21,991
1926	..	..	19,687	1931	..	..	19,391
1927	..	..	22,512	1932	..	..	19,704
1928	..	..	24,565				

Sources of Supply.—The most striking feature of imports was the change in sources of supply compared with 1931. Combined imports from the Netherlands, Denmark and Belgium, which are important suppliers to the British market and which shipped smaller quantities to that market in 1932, were 27 per cent. greater than in 1931, whereas aggregate imports from Central and Southern European countries declined by 36 per cent. in spite of increased supplies from Roumania. The Netherlands remained the largest single source of supply, accounting for 38 per cent. of total imports with an increase of 20 per cent. over 1931, and imports from Denmark increased two and a half times. There was a substantial decline in imports from Poland and smaller quantities were recorded from China. A noticeable feature was the marked growth of supplies from Finland.

*Institut für Landwirtschaftliche Marktforschung.

The following table gives details of the imports of eggs into Germany during each of the past four years :—

TABLE VII.—*Imports of Eggs into Germany*

Country whence consigned.	1929.	1930.	1931.	1932.
	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.	000 Gt. hds.
Netherlands	6,351	6,297	6,236	7,460
Denmark	1,464	1,046	1,163	2,722
Belgium	2,573	1,604	922	2,154
Roumania	1,455	2,339	1,786	2,092
Bulgaria	1,579	2,462	2,590	1,580
Russia	3,995	1,465	1,878	774
Finland	—	4	91	488
Yugo-Slavia	1,008	1,332	960	429
Poland	1,305	1,554	521	331
Lithuania	302	347	336	304
Italy	987	815	848	287
Sweden	181	206	146	271
China	343	610	495	208
Hungary	430	969	753	170
Estonia	197	210	174	156
Turkey	35	85	98	94
Czecho-Slovakia	204	262	138	40
Argentina	—	4	9	33
Austria	200	198	144	17
Australia	—	—	—	6
France	159	44	2	—
Other Countries	173	138	101	88
Total	22,941	21,991	19,391	19,704

FRANCE

FOREIGN TRADE IN BUTTER

Normally France figures as a net exporter of butter when production is at its maximum in spring and summer and as an importer in the winter months when production is at its lowest. Even with the increased imports in 1931 it is estimated that home production accounted for 94 per cent. of the total consumption of butter.

From being a net exporting country up to 1929, France became a butter importing country on a considerable scale in the two following years. As a result of various legislative measures (*see* page 106) imports in 1932 were considerably reduced, being 36 per cent. smaller than in 1931, according to the official figures, but greater than in any other recent year. The decline was particularly marked in the case

of supplies from Denmark, the chief source in earlier years, and also in the quantity received via the United Kingdom. Imports from the Netherlands almost attained to the previous year's level and Argentine supplies were more than double the figure for 1931.

Simultaneously with increasing imports, exports of butter from France had been declining, and a further marked reduction occurred in 1932. The greater part of these exports was to Algeria.

Details of the imports and exports of butter in the five years 1928 to 1932 are given in the following table:—

TABLE I.—*France : Imports and Exports of Butter*

—	1928.	1929.	1930.	1931.	1932.
<i>Imports—</i>	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
From Netherlands	11·7	19·1	18·6	65·2	63·0
Argentina	4·2	19·6	11·4	25·5	57·5
Denmark	6·1	25·3	50·6	102·7	40·0
United Kingdom	20·5	11·3	14·6	72·4	22·3
Other Countries	9·3	11·8	20·2	98·8	50·2
Total Imports	51·8	87·1	115·4	364·6	233·0
<i>Exports—</i>					
To Algeria	24·8	24·5	34·2	46·0	38·9
United Kingdom	71·4	34·3	5·7	1·5	3·0
Other Countries	125·6	90·5	68·2	51·0	28·8
Total Exports	221·8	149·3	108·1	98·5	70·7
Net Imports (+) or Exports(—).	—170·0	— 62·2	+ 7·3	+266·1	+162·3

BELGIUM

FOREIGN TRADE IN BUTTER

There has been a marked increase in imports of butter into Belgium during recent years and the increasing trend was continued in 1932, when imports were 13 per cent. greater than in 1931 and more than double the 1930 figure. Belgium thus became the biggest butter-importing country next to the United Kingdom and Germany. The increase compared with a year earlier, however, occurred principally in the first few months of the year, prior to the introduction of the quota (*see* page 107). Imports from May to December, 1932, were 22 per cent. smaller than in the corresponding period of 1931.

As in the two preceding years, Denmark was the chief source of butter imported into Belgium and supplied 50 per cent. more than in 1931, but imports from the Netherlands declined by 31 per cent. There was a further increase in the quantity shown as from the United Kingdom, which probably consisted chiefly of re-shipments of box butter and butter from Russia and Baltic countries. Imports consigned from the latter countries were on a smaller scale than in 1931, but imports from Germany, which would also probably consist mainly of re-exports, were on a larger scale.

The following table gives details of the gross and net imports of butter into Belgium during each of the past five years :—

TABLE II.—*Belgium : Imports and Exports of Butter*

Country whence consigned.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Denmark	1.0	17.2	74.8	130.6	195.6
United Kingdom	14.4	10.9	15.2	42.9	81.3
Netherlands	7.2	51.7	74.5	91.4	63.0
Estonia	(a)	(a)	(a)	35.7	15.2
Germany	(a)	(a)	9.5	12.4	14.8
Latvia	(a)	(a)	4.8	15.9	13.0
Poland	(a)	(a)	12.2	17.9	10.2
Lithuania	(a)	(a)	(a)	13.7	4.9
Other Countries	3.3	5.6	9.1	10.6	19.7
Total Imports	25.9	85.4	200.1	371.1	417.7
Exports	33.2	25.7	23.6	24.6	16.5
Net Imports (+) or Exports (-).	- 7.3	+ 59.7	+176.5	+346.5	+401.2

(a) Included in "Other Countries."

SWITZERLAND

FOREIGN TRADE IN BUTTER

Imports of butter into Switzerland increased appreciably between 1929 and 1931. As a result of various measures, which are discussed on page 108, imports of butter in 1932 were reduced to little more than one-third of the 1931 figure.

Details of the imports in 1932 show that smaller quantities were received from all the important sources, although only a slight decline occurred in the case of Argentine butter. Imports from

Denmark, which comprised more than half the total quantity imported, were one-third of the previous year's figure, and there was a greater relative reduction in supplies from Baltic countries.

The following table shows the imports of butter into Switzerland in the five years 1928 to 1932. Exports are negligible.

TABLE III.—*Imports of Butter into Switzerland*

Country whence consigned.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.
Denmark	89,013	84,485	83,371	114,707	39,599
Argentina	14,980	7,769	8,767	15,562	14,273
Poland	4	555	25,225	35,864	5,006
Estonia	} 228	2,337	6,004	9,873	2,284
Latvia					
France	39,862	29,129	11,230	5,321	1,108
Sweden	—	41	5,413	3,759	974
Lithuania	36	777	4,631	9,871	532
Italy	9,059	9,696	9,026	3,921	292
Australia	41	—	—	1,770	1,308
New Zealand	—	—	—	683	1
Other Countries ..	8,018	13,849	14,136	7,156	7,413
Total	161,241	148,638	167,803	208,487	72,760

ITALY

FOREIGN TRADE IN BUTTER

Imports of butter into Italy are comparatively small, but increased appreciably in 1930 and 1931. Following the increased importation in 1931, heavier tariff rates came into force in March, 1932. As a result, gross imports of butter in 1932 were 29 per cent. less than in the previous year. The decline was particularly marked in supplies from Argentina, the principal source, Poland and Hungary. Increased quantities were received from Russia and Australia.

Exports were also appreciably reduced in 1932, due chiefly to the almost entire cessation of supplies to Switzerland, but net imports declined by 27 per cent.

The following table gives details of the imports and exports of butter in each of the past five years.

TABLE IV.—Italy: Imports and Exports of Butter

	1928.	1929.	1930.	1931.	1932.
Imports.					
<i>Fresh Butter:—</i>	cwts.	cwts.	cwts.	cwts.	cwts.
Argentina	5,088	6,428	8,221	24,646	18,731
Russia	—	—	—	158	5,171
Australia	1,894	79	1,290	4,205	4,550
Hungary	24	2	2,677	7,421	2,596
Denmark	3,374	7,925	7,508	3,947	1,392
Poland	—	—	2,890	7,805	—
Other Countries ..	21,059	2,476	5,213	7,044	1,629
Total, Fresh ..	31,439	16,910	27,799	55,226	34,069
Total Imports (all kinds)	31,559	17,298	27,945	55,388	39,270
Exports.					
<i>Fresh, Salted, etc:—</i>					
United States of America	2,303	3,156	5,278	5,113	4,012
Switzerland	8,112	8,327	7,756	3,357	63
Other Countries ..	5,472	3,260	3,492	3,042	3,311
Total Exports	15,887	14,743	16,526	11,512	7,386
Net Imports	15,672	2,555	11,419	43,876	31,488

WHOLESALE PRICES FOR DAIRY PRODUCTS, 1926 TO 1932

In the following tables, prepared at the request of the Food Products Committee of the Empire Marketing Board, are shown annual average prices, from 1926 to 1932 inclusive, of certain dairy products, with the extreme range of prices during each year. The figures have been extracted from the Annual Statistics of the Ministry of Agriculture and Fisheries, which give average prices each month. Hence the ranges shown in the tables are only the ranges between the highest and lowest monthly averages.

The Ministry of Agriculture and Fisheries quotations are averages at representative wholesale markets in London, Bristol and Liverpool for imported provisions; and London, Bristol and Liverpool, together with about 25 country produce markets, for English butter and eggs. Hence the prices are not always first-hand prices, but generally represent the average prices paid by retailers to wholesalers.

Wholesale Prices of Butter, Cheese, Bacon, Hams, Eggs, 1926-1932

	1926.	1927.	1928.	1929.	1930.	1931.	1932.
Butter.							
<i>British</i> (per 12 lbs.) :—							
1st Quality—Average	22/6	21/6	22/11	22/6(c)	19/4(a)	17/-(a)	16/-(a)
Range	19/6 25/-	18/- 24/6	19/9 25/3	18/6 25/-	16/3 23/9	14/3 19/-	13/3 18/6
2nd Quality—Average	20/3	19/3	20/5	20/6	17/2	15/-	13/9
Range	17/9 25/6	16/3 22/-	17/9 22/6	16/9 22/6	14/3 21/3	12/3 16/9	11/- 16/-
<i>Australian (Salted)</i> (per cwt.) :—							
1st Quality—Average	169/6	169/6	171/-	175/-	135/6	116/6	105/-
Range	150/6 176/-	158/6 180/-	161/6 184/6	165/6 188/6	113/- 160/6	109/- 125/6	89/6 112/-
<i>New Zealand (Salted)</i> (per cwt.) :—							
1st Quality—Average	172/6	172/-	179/-	177/6	137/-	120/-	108/6
Range	152/6 179/6	159/- 185/-	165/- 187/6	168/- 190/-	115/6 162/6	111/- 126/6	91/6 119/6
<i>Argentine</i> (per cwt.) :—							
1st Quality—Average	160/6	169/6(c)	172/6(c)	174/-(c)	136/-(c)	117/6(c)	103/6(c)
Range	149/6 168/6	159/- 177/6	160/- 188/6	165/- 189/6	114/6 159/6	107/- 127/-	93/- 114/6
<i>Danish</i> (per cwt.) :—							
1st Quality—Average	185/-	184/-	192/6	186/6(e)	155/-(e)	135/-(e)	124/-(e)
Range	177/- 197/-	164/6 198/6	177/- 214/-	171/- 205/-	143/- 179/6	123/6 152/6	107/6 140/6
Cheese.							
<i>English Cheddar, Dairy</i> (per cwt.) :—							
1st Quality—Average	125/-	120/-	133/6	123/-(d)	105/6(d)	97/-(d)	105/6(d)
Range	101/6 144/-	112/6 130/-	123/- 142/6	106/- 137/-	93/6 121/-	89/6 103/-	92/- 116/6
2nd Quality—Average	116/-	108/-	127/-	116/6	96/-	86/-(d)	93/6(d)
Range	96/6 132/6	101/- 118/-	117/6 134/-	100/- 132/-	87/- 110/6	77/6 93/-	83/6 106/-

<i>Canadian</i> (per cwt.) :— 1st Quality—Average Range	99/- 88/- 112/6	99/6 92/- 107/6	111/- 105/6 116/-	104/- 94/6 112/-	95/- 79/6 103/-	75/6 67/6 79/6	72/- 66/- 78/-
<i>New Zealand</i> (per cwt.) :— 1st Quality—Average Range	95/6 88/- 104/6	95/- 80/6 107/-	106/- 96/- 116/6	94/6 91/6 99/6	82/6 65/6 92/6	63/6 54/6 72/6	64/- 60/- 67/-
Bacon. <i>British, Wiltshire, Green</i> (per cwt.) :— 1st Quality—Average Range 2nd Quality—Average Range	149/- 130/- 158/- 139/- 120/6 148/-	124/- 103/- 134/6 115/- 95/6 124/6	120/- 108/- 126/6 113/6 103/- 119/-	131/-(d) 114/6 139/- 122/6(d) 105/- 137/-	126/6(d) 108/- 147/6 117/6(d) 98/- 139/-	95/-(d) 75/6 114/- 84/-(d) 63/- 100/-	86/6 75/- 101/6 73/6 64/- 89/6
<i>Danish, Sides, Green</i> (per cwt.) :— 1st Quality—Average Range 2nd Quality—Average Range	127/6 106/6 141/- 123/- 101/- 133/-	98/- 85/6 111/6 93/6 81/- 108/6	99/6 85/6 115/6 95/- 79/6 111/-	115/6 98/- 129/6 110/6 89/6 125/-	97/- 71/- 114/- 92/- 66/6 108/6	65/- 50/6 77/6 61/6 46/- 73/6	61/6 54/- 71/6 59/6 49/- 69/6
<i>Canadian, Sides, Green</i> (per cwt.) :— 1st Quality—Average Range 2nd Quality—Average Range	115/6 97/6 129/6 109/- 92/- 119/-	90/6 77/- 103/6 86/6 74/- 99/6	92/- 78/- 108/- 89/6 76/- 104/-	109/- 89/6 123/- 106/- 85/6 120/6	99/- 90/- 107/- 95/- 86/- 103/6	— — — —	— — — —
Hams. <i>American, Long Cut, Green</i> (per cwt.) :— 1st Quality—Average Range 2nd Quality—Average Range	139/6 120/- 156/6 133/6 114/6 150/6	111/6 99/6 117/- 106/6 92/6 112/-	106/6 88/- 121/- 103/- 85/- 117/-	116/- 105/6 125/- 111/- 102/- 121/-	108/6 103/- 115/- 104/6 98/6 111/-	86/- 78/- 96/6 82/- 74/- 93/-	82/- 78/- 84/6 78/- 73/- 81/-

(a) Average prices town and country markets.

(c) Average prices London only.

(d) Average prices Bristol and London.

(e) Average prices Liverpool and London.

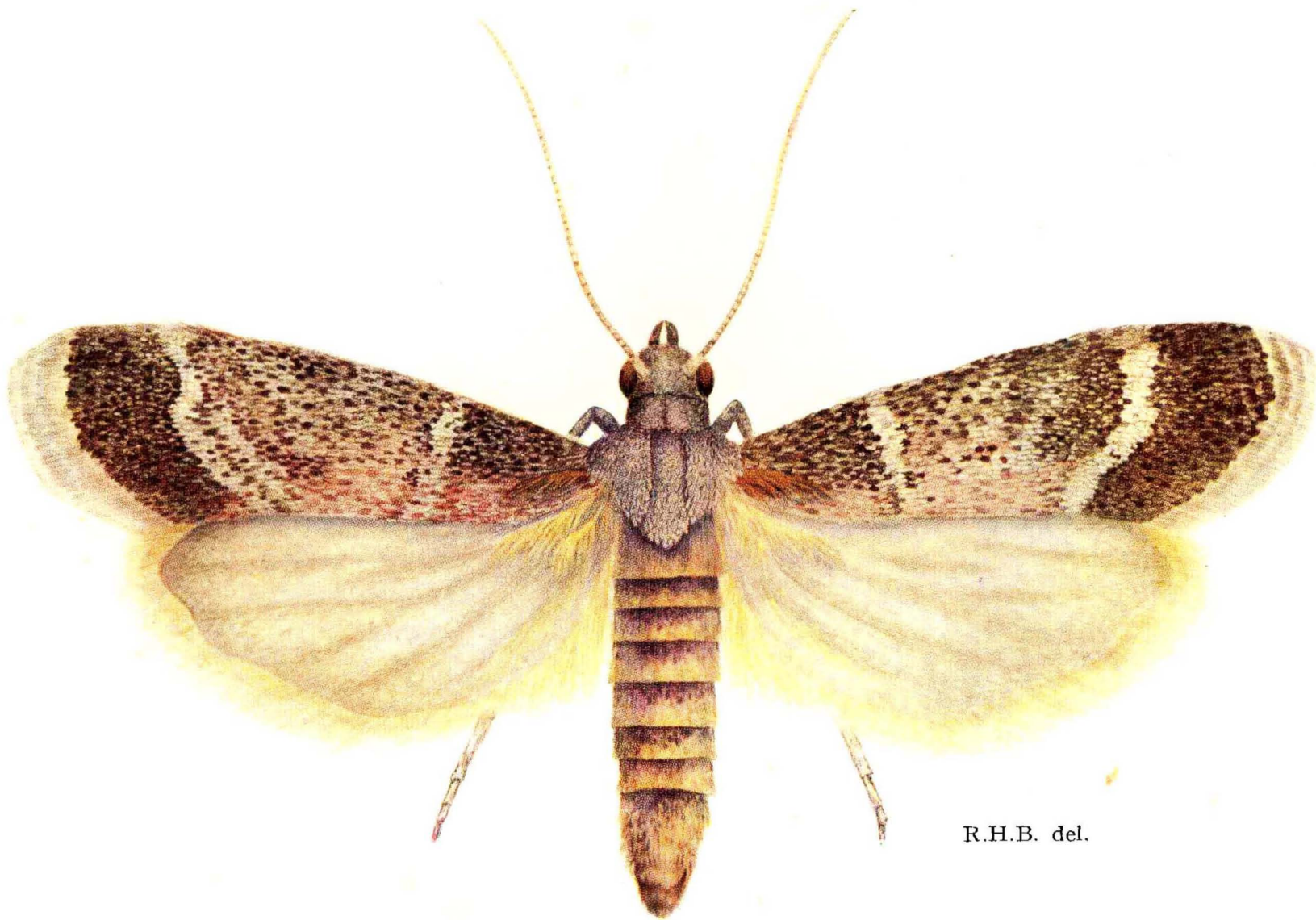
Wholesale Prices of Butter, Cheese, Bacon, Hams, Eggs, 1926-1932—continued

	1926.	1927.	1928.	1929.	1930.	1931.	1932.
<i>Eggs.</i>							
<i>British (per 120) :—</i>							
1st Quality—Average	19/2(a)	18/6(a)	18/9(a)	20/-(a)	17/3(a)	14/9(a)	13/9
Range	12/3 31/-	11/5 28/6	11/8 29/2	12/3 29/7	11/5 25/7	9/9 23/6	8/9 21/8
2nd Quality—Average	17/6(a)	16/8(a)	16/10	18/4	15/7	13/4(a)	12/6
Range	11/- 28/4	10/5 26/-	10/5 26/8	11/- 27/3	10/5 23/6	8/9 21/8	7/11 19/9
<i>Irish :—</i>							
Extra Select, 16 lbs.—							
Average	18/3	17/5(b)	17/5(b)	18/5(b)	15/8(b)	12/10(b)	12/9(b)
Range	11/5 28/6	11/8 25/11	11/8 26/4	12/2 27/3	10/11 23/9	9/3 17/5	8/4 19/11
Selected, 15 lbs. :—							
Average	17/2	16/7	16/9	17/8	15/-	12/2(b)	12/4
Range	10/8 26/11	11/- 25/2	11/3 25/7	11/6 26/3	10/4 23/-	8/9 16/5	8/1 19/4
<i>Danish :—</i>							
18 lbs.—							
Average	19/7	18/6(c)	18/6(c)	—	15/1(c)	14/1(c)	11/11(c)
Range	14/1 28/3	13/5 27/3	13/11 26/9	—	12/4 21/4	10/1 21/3	9/4 14/11
15½-16 lbs.—							
Average	17/-	16/2	16/3	—	13/3	12/5	10/3
Range	11/6 26/1	11/1 24/10	11/8 24/2	—	10/7 18/11	8/7 19/-	7/10 13/9
<i>Dutch :—</i>							
Brown.—							
Average	18/10(c)	17/8(c)	18/2(c)	19/9(c)	17/-(c)	14/3(c)	14/3
Range	12/8 28/7	12/4 25/3	13/4 25/7	14/6 26/10	12/11 23/9	10/7 20/8	10/1 24/2
Mixed.—							
Average	17/4	16/3	16/7	16/5	13/10	11/7(c)	12/5
Range	11/6 26/2	11/5 23/5	12/3 23/9	12/- 22/6	10/1 20/4	8/7 17/10	8/4 21/6

(a) Average prices town and country markets.

(b) Average prices Bristol and Liverpool and London.

(c) Average prices London only.



R.H.B. del.

Plate I. *Ephestia elutella* Hb., adult. × 9 (approx.)



REPORT ON THE
INFESTATION OF CURED TOBACCO IN
LONDON BY THE CACAO MOTH
EPHESTIA ELUTELLA HB

Prepared for the Empire Marketing Board's Committee on
Infestation of Stored Products

By

H. H. S. BOVINGDON, B.Sc., D.I.C.
Imperial College of Science and Technology
London



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PREFACE.

This report deals with the somewhat sudden appearance in tobacco stores in London of the moth *Ephestia elutella*, which until recently has been regarded mainly as a pest of cocoa. Its occurrence on tobacco in this country is of great importance to the tobacco industry and the report deals mainly with the problems affecting the home tobacco market. The sources at which tobaccos from overseas become infested by the moth are not yet definitely known but it is hoped that further work may be carried out on that aspect of the problem. Meanwhile the report describes the results of survey work carried out in London warehouses, experimental work showing the extent to which fire-cured and kiln-cured tobaccos are affected, and experimental work bearing on methods of dealing with the moth in warehouses and other stores.

The measures recommended in this report are low temperature storage of tobacco as a means of sterilising it and, where that is not possible, fumigation of tobacco and of premises in which tobacco is stored. It may be noted that these measures against the moth *Ephestia elutella* apply also to the control of the tobacco beetle *Lasioderma serricorne*. They are already being used in some branches of the tobacco industry in this country and it is to be hoped that thereby further increase and spread of this comparatively new pest of tobacco may be checked. One important possible source of trouble, however, may be referred to, namely odd parcels of tobacco which, for one reason or another, have not been absorbed in the general course of trade. Some of these parcels may have been rejected because they were infested by *Ephestia* and it is most important that dealers in, and buyers of, small parcels should realise the risk they may run or cause others to run by harbouring infested stocks.

The cost of this investigation has been borne, during the first year equally by the Empire Marketing Board and the Southern Rhodesian Government, and during subsequent years by the Southern Rhodesian Government and the Imperial Tobacco Company of Great Britain and Ireland. A minor contribution to the investigation was also made by certain other tobacco firms in this country.

Mr. Bovingdon has acknowledged in his report the assistance which he has received from various members of the tobacco trade but special acknowledgement should be made here to Mr. Anson of the Imperial Tobacco Company and to the High Commissioner for Southern Rhodesia, whose unfailing courtesy and encouragement have made the publication of this report possible.

J. W. MUNRO.

A.—INTRODUCTION

In November, 1929, the director of a London firm of tobacco merchants notified the Entomology Department of the Imperial College of Science and Technology, London, of an outbreak of insects in Rhodesian tobacco lying in the bonded warehouses of one of the large London docks. Specimens of the insect were submitted for identification and were found to be larvae and adults of *Ephestia elutella* Hb., commonly called the Cacao Moth.

The almost sudden appearance of a large number of moths in the warehouses and in the sample¹ rooms in the City, the peculiarity and extent of the damage wrought in the bales, and the unfamiliarity of the merchants with this new pest caused serious alarm among those engaged in the tobacco trade. The questions freely discussed were:— Was it probable that the tobacco was infected whilst it lay in store in London? Would the pest die out with the onset of winter or was there a possibility of its spreading? Was the insect already known to attack cured tobacco?

These queries formed the basis of an inquiry, the results of which are set out below. In addition, several other aspects of the problem have been taken up as opportunity occurred with the aim of making the investigation as complete as possible. However, as the work progressed, other problems, subsidiary to the main problem, have arisen and extended the work, so that even now many of the questions remain incompletely solved, whilst others are awaiting an opportunity for investigation. In their wider aspects many of these subsidiary problems are of the highest importance in the work on the infestation of stored products.

(1) The Disclosure of the Outbreak

Suspensions of the trouble were first engendered at about the end of August, 1929, when numbers of moths were seen flying in the tobacco warehouses at the docks. These were followed by the discovery of numerous larvae both inside and crawling over the bales.

¹ For this and other terms used in the tobacco trade and in entomological work see the glossary at the end of this report.

As, up to that time, *Ephestia* had not been noticed in tobacco in England, it may be assumed that the larvae, which had given rise to the moths seen flying at the end of August, had been either overlooked altogether or mistaken for the larvae of *Lasioderma serricorne* F., the tobacco "weevil," a beetle well known to the trade before 1929. That the mistake had really been made will be referred to again later. A more detailed examination by the tobacco warehouse-keepers and merchants, however, revealed the differences between the two insects, and thus the tobacco trade found itself, for the first time, face to face with what has proved to be a very serious pest.

A perusal of the literature on *Ephestia elutella* showed that, so far as could be ascertained, it had been recorded only twice previously in cured tobacco, once in Russia (Mokrzecki and Bragina, 1915),¹ and once in Bulgaria (Tchorbadjef, 1929).

(2) The affected Tobacco

In 1927 and 1928, large quantities of leaf had been imported from East Africa and, as a consequence of overproduction coupled with the slumping of prices at home, large stocks were on hand. The tobacco in which *Ephestia* was first discovered had come from Southern Rhodesia and had been in bond for about two years. Subsequently, it was found that Nyasaland tobacco in the same warehouses had also been attacked but, on the whole, had not suffered to the same extent as that from Southern Rhodesia. In the opinion of the merchants this was due to its lesser capacity for absorbing moisture.

(3) Source of the Infestation of 1929

The source of the infestation was a much discussed question. Various opinions were put forward, among which were: (1) that the source of infestation was Southern Rhodesia; (2) that the seat of infestation was at Beira, in Portuguese East Africa, where the tobacco may be stored for some time prior to shipment; (3) that the bales were shipped and stored together with other infected products; and (4) that it was infected whilst it lay in the bonded warehouses in London. A full discussion will be given further on.

¹ Refer to the bibliography for the titles of papers published by authors mentioned in this report and for the names of the publications in which the papers are to be found.

(4) The enormous Stocks in Bond

Undoubtedly the large stocks of Rhodesian bright tobacco held in bond in the London warehouses in 1927, 1928 and 1929 was one reason for the severity and suddenness of the outbreak. This accumulation of stocks was due principally to the Imperial Preference Tariff which, in September, 1919, was granted to all Empire tobacco by an allowance of a rebate of one-sixth of the full import duty. This was increased to one-quarter of the full rate in 1925, and in the next year this figure was stabilised until 1st July, 1936. In recent years the preference amounted to more than the value of the leaf itself and was the direct cause of a stimulated activity in tobacco growing within the Empire, especially in East Africa. For example, the crop produced in Southern Rhodesia in 1926 was thirty times that grown in 1918, and in Northern Rhodesia the increase was 4.25 times. In other countries where special developments were taking place the increases were as follows:—Nyasaland, 4.25; Canada, 2; and the Union of South Africa, 1.25 (Tobacco Report, 1928).

Table I shows the quantities of the imports of tobacco from Rhodesia and Nyasaland into the United Kingdom for the years 1925 to 1931. Thus in 1928 the tobacco had arrived in far greater quantities than could be dealt with in manufacture and re-export and, consequently, the stocks soared above the normal two years' supply.

TABLE I.—*Imports of Tobacco from Rhodesia and Nyasaland*

Year.				Nyasaland.	North and South Rhodesia.
				lbs.	lbs.
1925	..	..	..	7,300,385	993,863
1926	..	..	..	9,157,582	2,323,322
1927	..	..	..	14,033,665	10,947,858
1928	..	..	..	13,491,534	12,122,671
1929	..	..	..	10,739,171	5,175,881
1930	..	..	..	12,902,881	4,372,653
1931	..	..	..	11,168,288	6,230,433

Table II gives the stocks of Nyasaland and Rhodesian tobaccos held on 1st January, 1926, 1927, 1928, 1929, 1930 and 1931.

TABLE II.—*Quantities of Tobacco in British Warehouses*

Country.	Year.	Stocks on hand on Dec. 31st.	Deliveries during the year.	Number of years' stock on hand.
Nyasaland ..	1926	10,308 ¹	7,845	1 $\frac{1}{3}$
	1927	16,791	7,200	2 $\frac{1}{3}$
	1928	19,836	7,572	2 $\frac{1}{3}$
	1929	17,359	6,722	2 $\frac{1}{3}$
	1930	17,835	6,918	2 $\frac{1}{3}$
	1931	16,515	6,574	2 $\frac{1}{3}$
Rhodesia.. ..	1926	1,825	1,045	1 $\frac{2}{3}$
	1927	9,652	2,016	4 $\frac{1}{3}$
	1928	17,235	4,209	4 $\frac{1}{3}$
	1929	16,882	5,179	3 $\frac{1}{3}$
	1930	13,916	6,669	2 $\frac{1}{3}$
	1931	11,534	6,792	1 $\frac{2}{3}$

¹ Thousands of lbs.

The amount of Empire-grown tobacco imported into the United Kingdom in 1927 had increased to 550 per cent. of that imported in 1921, whilst during the same year the imports of tobacco from foreign countries had decreased by 18 per cent. From the time of the granting of the Imperial Preference up to about 1929 a large proportion of the augmented imports of bright tobaccos of Empire origin was used in the manufacture of pipe tobaccos. These bright tobaccos replaced corresponding types from foreign countries.

The increase in the popularity of cigarette smoking during recent years was largely responsible for the greater use of bright tobacco, but the extra stocks required were mainly drawn from the United States of America.

(5) *Description of Ephestia elutella* Hb.

Ephestia elutella belongs to a family of small moths called the Phycitidae and in the fully extended flying position, as depicted in Plate I, measures about $\frac{5}{8}$ in. across the wings. The fore-wings are



FIG. 1. *E. elutella*, egg. $\times 50$ (approx.)

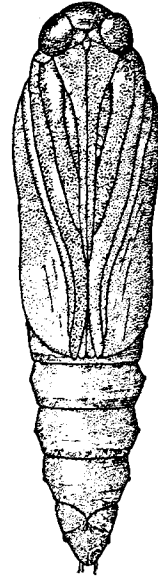


FIG. 3. *E. elutella*, pupa. $\times 9$ (approx.)

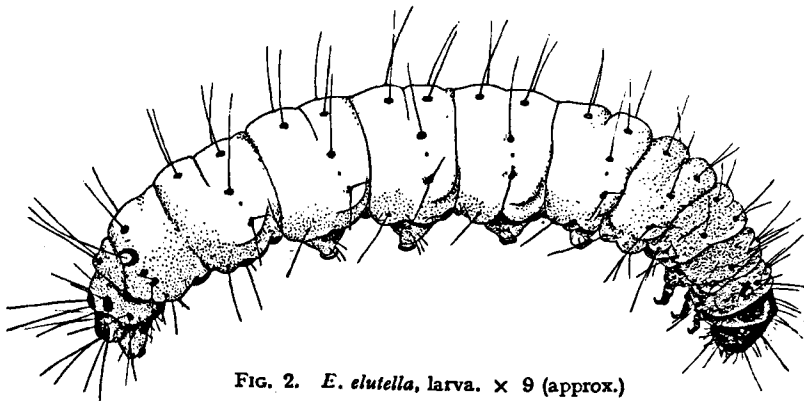


FIG. 2. *E. elutella*, larva. $\times 9$ (approx.)



FIG. 4. *E. elutella*, adult in resting position $\times 9$ (approx.)

brownish-grey in colour but the shade is very variable, some specimens being darker and some much lighter than others. The wing is crossed by two oblique lines which, in the lighter specimens, may have more or less wide, dark borders. In the dark specimens these borders tend to merge into the general ground colour of the wings and are indeterminate. In many moths the lower edge of the wings is distinctly brown. The hind-wings are of a uniform brownish-grey edged with a narrow darker and a lighter line. The body is of the same hue as the wings.

The egg (Plate II, Fig. 1) is dull white and warty and measures about $\frac{1}{10}$ in. by $\frac{1}{10}$ in. The larva (Plate II, Fig. 2) when fully grown is about $\frac{1}{2}$ in. long and dull, creamy white. The head and the small plate of thickened skin behind it, together with another smaller plate on the last segment, are brown in colour. In addition to three pairs of jointed legs on the first three segments of the body there is a series of five pairs of modified, wart-like legs, a pair being situated on each of the sixth, seventh, eighth, ninth and last segments. The sole of each of these legs, or pads, is provided with a circular row of fine hooks. The hairs of the body are moderately few and in the older larva are arranged as shown in the figure. Those on the back and sides arise from the centre of small, blackish-brown spots. The pupa is shown in Plate II, Fig. 3. At first the colour is very pale yellow, but in a few days the pupa becomes more heavily pigmented, turning almost black by the time the moth is ready to emerge.

(6) Commodities upon which *E. elutella* feeds

In this country and elsewhere *E. elutella* is well known as a pest of cacao beans and chocolate. In addition, it has been recorded as feeding upon dried fruits, coffee, various nuts, cotton cake, chicory, flour and cereals, ship's biscuits, cayenne pepper, tobacco, etc. (Mokrzecki, 1915; Zacher, 1927; Munro and Thomson, 1929; Richards and Herford, 1930.) Considering the wide variety of food-stuffs, it is not surprising to find that, notwithstanding the nicotine in cured tobacco, the leaf is readily consumed by the larvae.

(7) *Ephestia* and the Nicotine in Tobacco

The percentage amount of nicotine contained in cured tobacco leaf varies between 1 per cent. and 4 per cent., the brighter types of leaf generally containing less than the darker. The larvae of *Ephestia*

ingest this quantity of nicotine with their food with no apparent ill-effect. The beetles, *Lasioderma serricorne* F., and *Catarama tabaci* Guer, can also feed and complete their life-history upon the same foodstuff. Even when the tobacco is growing in the field it is attacked by various insects, the contained nicotine giving the plant no protection against the pests. Besides being able to eliminate nicotine from its system, or at least being able to render it innocuous to its life, the *Ephesia* larva apparently does the same with the drugs caffeine and theobromine when feeding upon cacao beans, which, when cured, may contain from 1-2 per cent. (Whympers, 1921). Therefore, the fact that tobacco contains a poisonous alkaloid does not preclude that product from forming a very suitable pabulum for the development of this moth.

B.—SURVEY WORK IN THE WAREHOUSES

(1) Examination of Bales

Tobacco reaches this country packed in bales or in casks, that from East Africa usually being in hessian-covered bales weighing about 200 lb., the dimensions of which are about 3 ft. by 2 ft. by 1 ft. 3 in. When making a survey of a consignment of tobacco, a number of bales, generally about 5 per cent., were selected at random and each subjected to the following examination:—

The bale was opened by cutting the string along two adjacent sides. It was then placed on one "cap", i.e., a side measuring 3 ft. by 2 ft., and the hessian covering taken off to expose the opposite "cap" and the sides. The exposed parts were then examined, the layers of "hands" being lifted and every here and there a "hand" being extracted for closer scrutiny. After looking at the four sides to within one or two layers from the floor the hessian was pulled back into place and the bale turned right over on to the already examined "cap". The top "cap" was then exposed and examined together with the remaining parts of the sides.

The tobacco was sometimes brittle and easily broken and therefore the bales were not subjected to rough handling or unnecessary disturbance. It was, however, found that the above-described method of examination was very effective as in extremely few cases did the damage reach to more than four or five inches from the

surface of the bale and tobacco lying at that depth could be easily exposed by lifting the "butts" of the "hands". Undoubtedly a very slightly infected bale was occasionally overlooked and passed as clean, but in every case, where a whole consignment or parcel showed no signs or very slight signs of infestation, a greater amount of care was exercised in the examination.

A really thorough examination of a bale, after which one could say that it was definitely clean, was out of the question, as it would have entailed its being pulled to pieces for the examination of each individual "hand" of tobacco.

In addition to the tobacco itself attention was always given to the hessian wrapper, into the folds of which the larvae crawl from the leaf to pupate. Hundreds of pupae and larvae preparing to pupate were thus discovered.

(2) Infestation of the Sample Rooms

At the time the pest was first revealed in the warehouses, moths were simultaneously found in the sample rooms of tobacco merchants and brokers in London. These moths had evidently arisen from eggs or larvae which were on the leaves when taken from bales, either during "sampling," which takes place directly the bales arrive in England, or during "re-sampling".

It is evident that the "samplers", having had no previous experience with *Ephestia* and its depredations, had mistaken the larvae and frass which they occasionally came across for those of the well-known tobacco "weevils". That such confusion had occurred was first realised in January, 1930, when re-sampling was proceeding in six bales of Rhodesian tobacco. Several bales had already been finished when the examination for *Ephestia* was begun and the new samples made up for despatch to the city. The first bale examined contained a fair amount of frass and damage which was clearly caused by *Ephestia*. This, however, was passed over by the sampler as being due to "weevil" and was considered of no consequence. A small live larva of *Ephestia* was subsequently found in the same bale and the other five bales all contained the pest in one form or another, as will be seen from Table III.

TABLE III.—*Examination of Bales*

Bale.	Amount of Frass.	Adults.	Pupae.	Larvae.
2	Moderate	None	None	2 live larvae.
3	"	"	2 pupae	1 live larva.
4	"	"	"	2 larvae pupating.
5	"	"	"	1 live larva.
6	"	"	"	None.

If the attention of the workman had not been called to the presence of the insect in bale 1, the other bales would certainly have been re-sampled and the samples passed out of the docks with every chance of their being infested. From this and similar incidents it may be concluded that, at times, infected samples had been unwittingly sent to the city sample rooms which, in due course, became badly infested. Larvae and pupae have repeatedly been found in old samples which have been returned from the city to the warehouses when re-sampling was called for. These were re-packed into their respective bales and new samples drawn. For example, in January, 1930, eight bales from a consignment which had arrived in London 12 months previously were examined whilst re-sampling was proceeding. Seven of the bales were infested and by searching the old samples two were found to contain frass and damaged tobacco, one contained a live larva and in the fourth was a live adult.

(3) Packing of Exported Tobacco relative to its Infestation by *Ephestia*

Prior to the outbreak of the moths in question, East African tobaccos for export were packed almost solely in bales. However, owing to the greater facilities for obtaining a sufficient quantity of soft woods, casks are now being used in larger numbers. Casks or hogsheads certainly protect the leaf from mechanical injury, but it is uncertain whether they afford a greater protection from insect attack than that offered by bales. From the experience gained since August, 1930, it would seem that tobacco in hogsheads, such as those in which American tobacco is packed, is quite as prone to infestation by *Ephestia*

as that packed in bales. There are always fissures in the casks due to the imperfect fitting of the staves, to the damage caused during transport and to the "breaking open" of the casks during sampling. Through these cracks and openings moths and larvae can easily crawl.

In East Africa there are three methods of wrapping bales. They are:—(a) In a single wrapper of hessian; (b) in two wrappers of hessian; (c) in one hessian wrapper over tarred, brown paper. A study has been made of the efficiency of each of these methods with reference to the protection they give to tobacco from attacks by *Ephestia*.

Bales covered with single hessian

A single covering of hessian gives extremely little protection to the tobacco unless the fabric is thick and very closely woven. Usually, the inferior grades of hessian are woven so loosely that they have a sieve-like appearance. The female moth is provided with a moderately long, extensible ovipositor which it can insert into very small holes. Arkhangelskii (1931) made experiments which showed that the moth can oviposit through sacks, the fabric of which had meshes $\frac{1}{8}$ in. wide, but no eggs occurred either outside or inside sacks of more closely woven material. Young larvae are able to pass through sacking, the meshes of which are $\frac{1}{4}$ in. wide, but not through meshes $\frac{1}{10}$ in. wide. Therefore, any hole over $\frac{1}{4}$ in. wide gives ample room either for the direct egg laying or oviposition upon the tobacco, or for the entrance of a larva arising from an egg laid on the exterior of the hessian. Even if a hessian of good quality is used, holes invariably develop from the rough handling which the bales suffer during their transport from packing-shed to factory. The steel hooks used by the workmen for shifting the bales are responsible for much of the tearing of the wrappers and, so long as the practice prevails, baled tobacco is readily liable to infestation by *Ephestia*.

Double hessian wrappers

For reasons mentioned above, double hessian wrappers are also of very little use in preventing *Ephestia* from infesting tobacco leaf. If protected from injury, a double covering of stout hessian of good quality would give the tobacco a certain measure of security, but one must remember that any small imperfection in the weaving of the hessian will afford access to newly-hatched larvae, which can squeeze

through openings less than $\frac{1}{32}$ in. across. Table IV, shows the results of an examination in December, 1929, of fourteen bales selected at random from a consignment received in London in February, 1928. All the bales were covered with double hessian.

TABLE IV.—*Examination of Bales (double hessian covered)*

Bale Number.	Amount of frass and web.	Number of adult moths.	Number of pupae.	Number of larvae.
1	Little	None	None	None
2	"	"	"	"
3	"	"	"	"
4	Moderate	"	2 alive	"
5	None	"	None	"
6	Little	"	"	"
7	"	1 dead	"	"
8	"	None	1 alive	1
9	"	"	None	None
10	"	"	"	"
11	"	"	"	"
12	"	2 dead	"	"
13	Moderate	None	"	"
14	None	"	"	"

From another consignment, which arrived in January, 1929, eight bales were examined in January, 1930, and the following results obtained. (Table V.)

TABLE V.—*Examination of Bales (double hessian covered)*

Bale Number.	Amount of frass and web.	Number of adult moths.	Number of pupae.	Number of larvae.
1	None	None	None	None
2	Little	"	"	"
3	"	1 dead	2	"
4	Moderate	None	"	"
5	Little	1 dead	"	"
6	"	None	1 alive	"
7	"	1 dead	"	"
8	Moderate	None	"	"

Out of 22 bales only 3 were unaffected, from which it is evident that with the existing methods of handling the bales, the practice of using a double hessian wrapping is of no avail in reducing the risk of infestation.

Bales covered in paper and hessian

In this type of packing the tobacco is first wrapped in a sheet of tough, tarred, brown paper, the sheets being large enough to allow wide overlaps on the sides of the bale. Over this is a hessian wrapper. A perfectly intact wrapping of this kind would undoubtedly afford ample protection against infestation. Young larvae hatching from eggs laid upon the hessian, or upon the brown paper, would have to crawl a considerable distance between the overlaps to reach the tobacco underneath. However, in spite of the low powers of endurance of newly-hatched larvae, the possibility of an entrance being effected in this way is not remote. There is generally enough tobacco debris between the wrappers and the overlaps to give sustenance to the young larva, either for its partial, or for its complete development. Nevertheless, the protection afforded by a paper-hessian wrapper must be considerable, for in almost every bale examined which had this type of covering the larvae and frass were localised in the places where the wrappings were perforated and damaged, i.e., principally at the corners.

Table VI gives the extent of infestation of nine bales of East African tobacco covered in this manner.

TABLE VI.—*Examination of Bales (paper-hessian covered)*

Bale Number.	Amount of frass and web.	Number of adult moths.	Number of pupae.	Number of larvae.
1	Large	None	1	2 alive
2	"	3 dead	Many in hessian	3 alive
3	"	None	"	None
4	"	1 alive	None	1 alive
5	"	None	Some in hessian	None
6	Little	"	None	1 alive
7	"	"	"	2 alive
8	Moderate	"	Some in hessian	1 alive
9	"	"	"	Some alive

All the bales were damaged, the hessian and the paper wrapper being torn in places, due to the rough handling on the ships, to the use of hooks or to the opening of the bales during sampling or re-sampling. No hessian-paper covered bale has been examined in the warehouses which was not sufficiently damaged to allow the free oviposition by the *Ephestia* female. The sealing of the overlapped paper has been recommended. This would stop the ingress of insects between the sheets of paper, but the security of the bale from infestation is preserved only so long as the paper is undamaged. If bales could be imported in good condition this sealed packing would do much towards preventing serious infestation.

The preceding remarks apply equally well to other bales in which *Ephestia* has been found, e.g., in Turkish tobacco from Greece, Russian Maikop tobacco and the Turkish leaf from Cape Province. Such bales are usually covered with a single or double hessian wrapper.

(4) The origin of the pest in the London Tobacco Warehouses and the sources of infestation

Local sources

When the outbreak in the London warehouses was first reported it had already reached large proportions and it was evident that very little could be done in tracing the real origin of the 1929 infestation. All evidence of this beginning would have been obliterated in the time which had elapsed since the first moths or larvae reached the warehouses. Investigations during 1931 have proved that the insect is periodically brought over in tobacco from abroad and it is probable that the primary infestation had the same source. However, this knowledge was not available in November, 1929, and the general opinion then held was, that the infestation was the result of a minor infection from some local source of moths which had spread as a result of the unclean conditions in the tobacco warehouses.

This seemed a probable explanation in the light of an inquiry made in February, 1930, to ascertain whether the insect was being imported from East Africa. It was found that, in the period May, 1927, to

September, 1929, twenty-five consignments of Rhodesian and Nyasaland tobaccos had reached London, and each been divided up and distributed among four groups of bonded warehouses. Consequently, if East Africa was a source of the pest there was an equal chance that all these warehouses would contain one stage or other of *Ephestia*.

The four groups of warehouses were designated "A", "B", "C" and "D," and Table VII shows how the consignments were distributed. Searches for the insect conducted in "B", "C" and "D" proved negative, and the officials and workmen in those warehouses denied having seen any trace of the pest or of tobacco damaged by it. Thus, the allegation that group "A" was infested because of its dirty condition seemed to have some grounds, and imported tobacco from East Africa did not appear responsible for having introduced *Ephestia* into London. However, later on in 1930, when a more detailed search was made possible by the granting of further privileges in the warehouses, moths were found in group "B", but it could not be proved whether these insects had been introduced in a cargo which had arrived before September, 1929, or in one which came in afterwards.

It could not be said that the warehouses in group "A" were less clean or more neglected than the rest. Apart from one building, the warehouses in "A" were fairly old and difficult to clean, the floors and ceilings being of wood and the walls of brick. Nevertheless, the general state of the places was good, although in many ways the conditions could have been improved. Similar considerations can be applied to "B" and "C" which comprise similar, old buildings. On the other hand, the warehouses of group "D" were all of modern type. The conditions there were on the whole good. No commodities normally or occasionally infested by *E. elutella*, except tobacco, are landed at "A" and the insect has not been reported in any warehouses in its vicinity. A few miles up the Thames, however, the insect exists in large numbers in the cacao and dried fruit warehouses. But, so far as is known, no movement of goods takes place between these warehouses and those in "A." Grain is imported nearby "A" but only *Ephestia kühniella*, the Mediterranean flour moth, has ever been reported there. Therefore, it would seem that there is little probability that the infestation in question arose from local sources.

TABLE VII.—*Distribution of East African Tobacco in the London warehouses*

Ship.	Time of Arrival.	Group "A."	Group "B."	Group "C."	Group "D."
3	May 1927	X	X	—	—
4	July 1927	X	X	—	—
5	Aug. 1927	XE	X	—	—
2	Aug. 1927	X	X	—	—
6	Sept. 1927	X	X	—	—
7	Sept. 1927	X	X	—	—
9	Oct. 1927	XE	X	—	—
1	Nov. 1927	X	X	—	—
10	Nov. 1927	X	X	—	—
11	Dec. 1927	XE	X	—	—
2	Aug. 1928	X	X	—	—
12	Aug. 1928	X	X	X	—
13	Aug. 1928	X	X	—	—
14	Aug. 1928	XE	—	X	—
15	Sept. 1928	X	X	X	—
16	Oct. 1928	XE	X	—	—
17	Oct. 1928	XE	—	X	—
8	Dec. 1928	X	X	—	—
18	Jan. 1929	X	X	—	—
19	Feb. 1929	X	X	—	—
8	Apr. 1929	X	X	—	—
20	June 1929	X	X	—	—
13	July 1929	X	X	—	—
21	Sept. 1929	X	X	—	X
1	Sept. 1929	X	—	—	X

(X) shows how the consignment was apportioned between the groups.

(E) signifies that that portion of the consignment was infested by *Ephestia*.

East African sources

Throughout the work the idea that the pest was being imported into this country from abroad was kept in mind. At the very outset of the investigation the High Commissioner for Southern Rhodesia caused a cable to be despatched to Salisbury, asking for information as to the presence of *Ephestia elutella* in the curing sheds and warehouses of that country. The reply stated that an examination of stored tobacco in warehouses, barns, etc., in and around Salisbury

gave negative results. The transit sheds at Beira, in Portuguese East Africa, and a tobacco and cigarette factory in the neighbourhood of that town, were also inspected but no trace of *Ephestia* was discovered. (Jack, 1929).

In January, 1930, twenty-four bales of Rhodesian tobacco, selected haphazard from a consignment, received from Africa a few days before, were examined for damage for *Ephestia*. They were stored in "C" warehouses. No insects were found and, so far as could be ascertained, the bales were clean. The next opportunity for searching tobacco immediately after its arrival in London occurred eleven months afterwards when the owners of an infested consignment called upon me to examine it. Since then several similar examinations have been made.

The following particulars refer to the consignments of tobacco from Southern Rhodesia which have been found infested by *Ephestia* :—

December, 1930.—Southern Rhodesian tobacco found infested by *Ephestia* on being received from the ship. Leaves much eaten and quantities of frass and webbing adhering to them. Empty pupal cases obtained from the hessian wrappers.

January, 1931.—Tobacco from Southern Rhodesia reported damaged by *Lasioderma serricorne*. *Ephestia* larvae and frass also found. Adults reared from the larvae identified as *E. elutella* Hb.

March, 1931.—Tobacco found to be badly damaged by *Ephestia*. Live and dead larvae and pupae collected. Adults reared identified as *E. elutella*.

January, 1932.—Southern Rhodesian tobacco containing frass and damaged leaves due to *Ephestia*. No larvae found.

June, 1932.—Report received from the London warehouses that several bales of Southern Rhodesian tobacco infested by *Ephestia* had been landed.

In April, 1930, specimens of *E. elutella* were found in Southern Rhodesia in imported chocolate, and in the following June it was discovered in stored tobacco in Salisbury. (Mossop, 1932.)

A much lesser quantity of cigarette tobacco is imported from Nyasaland than from Southern Rhodesia, yet, there are reasons for suspecting Nyasaland tobacco of carrying *Ephestia* into Britain. Even if the tobacco left the packing-sheds in a clean condition there

is the possibility, if it is held up for any length of time in Beira, of its becoming contaminated by storage alongside infested produce arriving from neighbouring countries or, even from Nyasaland itself.

The only published record which appears to refer to *Ephestia elutella* in Nyasaland, is by Mason. (Mason, 1915.) He reports the presence of a Pyralid moth on groundnuts and says that this commodity is usually infested by that insect in some of the southern districts of the country. In the "Review of Applied Entomology" (R.A.E. Series A, Vol. IV, 1916, p. 9), the name of the insect is given as *Ephestia elutella*, but on the identification files of the Institute of Entomology the specimen sent from Nyasaland is recorded as *Ephestia cautella* Walk.

While the identity of this Pyralid moth is unfortunately confused, one cannot ignore the possibility that groundnuts from Nyasaland may play a part in the infestation of Southern Rhodesian tobacco at Beira or at other centres where groundnuts and tobacco are stored together. A full account has recently been published of the moths of the genus *Ephestia*, which deals with their identification, food and geographical distribution and should be valuable in furthering the study of the distribution of *E. elutella* and its allies. (Richards and Thomson, 1932).

Only one report of Nyasaland tobacco infested by *Ephestia* on its arrival in England has been received. In September, 1932, a consignment of Nyasaland leaf heavily infested by *Ephestia* larvae and pupae was landed in London. Most of the insects were found in the hessian wrappers, which had to be destroyed and replaced by new ones. The tobacco was not badly damaged. With this consignment were shipped other Nyasaland tobacco and also some from Southern Rhodesia, all of which appeared to be clean. Small infestations may have been accidentally overlooked or, for fear of reducing the value of the leaf, the knowledge of such infestations has been kept quiet. Moreover, other ports such as Liverpool or Glasgow may have received infested tobacco from Nyasaland without its becoming common knowledge in London. In 1930, the warehouses "A" stored only about 30 per cent. of the total tobacco imported into the United Kingdom from Nyasaland.

The suggestion that Beira is a source of infestation of tobacco may be applied to leaf coming from Northern Rhodesia and passing through that port, but in the Northern Rhodesian tobacco inspected

by samplers on its arrival in London no trace of *Ephestia* has been reported. Nevertheless, until they have been proved to be free from the pest, Nyasaland and Northern Rhodesia should be considered as potential sources of *Ephestia* in imported tobacco.

South African sources

Before 1931, there were reasons for believing that *Ephestia* was already present on various products in Cape Colony, although no published statement to that effect has been found by the writer. The existence of the moth on cured tobacco from that country is now certain, for Turkish leaf from the western province of Cape Province has been found infested. Particulars of three such consignments are given below :—

June, 1931.—Turkish tobacco leaf landed at Southampton and brought to London by railway. Nearly all the bales damaged by *Ephestia*, some very seriously.

August, 1931.—Tobacco received and found to be infested by *Ephestia*. Many dead larvae discovered. The bales appear to have been fumigated.

August, 1931.—Turkish leaf from Cape Province brought to London via Southampton, found damaged by *Ephestia*.

Our imports of South African tobaccos are not large. In 1928 they were 872,434 lb. ; 1929, 230,174 lb. ; 1930, 196,747 lb. ; and 1931, 114,457 lb.

European sources

Mokrzecki and Bragina (1915) discovered *E. elutella* on dry tobacco in Russia, in 1915. The British imports of Russian leaf are small, and in 1927, 1928 and 1929 amounted respectively to 13,701 lb., 4,955 lb. and 17,779 lb. A quantity of Turkish leaf from Maikop, Caucasia, was examined in March, 1930, and found to be badly infested by *Ephestia*, but, as the consignment had been shipped to London from Hamburg and may have been in store in London for some considerable time, the origin of the infestation is problematical.

Ustinov (1932) mentions that *E. elutella* is present everywhere in Georgia in S. Russia.

In Bulgaria, Tchorbadjef (1928) records the pest in stored tobacco. Recent correspondence with a German firm engaged in fumigating tobacco in Southern Europe confirms the report that *Ephestia* is

prevalent in that country. The Polish Government has protested against the badly infested tobacco which is being imported from Bulgaria. Although the quantity of Bulgarian leaf imported into Britain is not large—the annual imports between 1926 and 1930 averaged 110,228 lb.—these facts are sufficient to justify a suspicion that this tobacco is another source of infestations in British tobacco warehouses.

In Poland, Mokrzecki (1931) writes that *Ephestia* has in recent years become an important pest in stored tobacco and that it was probably introduced from Bulgaria whence most of the tobacco originates. The tobacco trade in Greece also appears to be seriously troubled by this pest. It is said that 20 per cent. of the damage caused by insects to cured tobacco in that country may be ascribed to *Ephestia*. From the examinations given below it is evident that much of the leaf coming into Britain is infested. In the period 1926 to 1930 about 740,500 lb. of tobacco has been imported annually from Greece and about 50 per cent. of this quantity was stored in "A" group of warehouses.

October, 1931.—A number of bales of Macedonian Turkish tobacco very badly infested with *Ephestia* and *Lasioderma serricorne*. Shipped from Cavala to Amsterdam and thence to London.

October, 1931.—Several bales of Turkish tobacco direct from Cavala were seriously infested with *Ephestia* and *Lasioderma*. The larvae and pupae of *Ephestia* were so numerous in the hessian wrappers of the bales that the wrappers were destroyed and new ones made.

November, 1931.—Several bales of Turkish tobacco, direct from Patros, Greece. Badly attacked by *Ephestia* and *Lasioderma*. Several live *Ephestia* discovered.

November, 1931.—Many bales of Turkish tobacco direct from Piraeus, Greece. All damaged by *Ephestia*.

In 1929 much of the infested tobacco from London was taken to the Continent and sold. Whether *Ephestia* was present in the tobacco warehouses in the continental North Sea ports before 1929 is not known to the writer. However, it seems probable that it is now present in places such as Hamburg and Amsterdam which carry on a large trade in tobacco, especially with the countries bordering the eastern Mediterranean and with the East Indies. *Ephestia* on tobacco

is now widely spread over Eastern Europe and its distribution may extend throughout the Continent as far west as the North Sea ports.

Ephestia on cured tobacco in the United States of America

According to Back and Reed (1930) *Ephestia* was unknown on cured tobacco in America before August, 1930 when it was found in a small number of warehouses in Richmond, Virginia. This discovery has thus further extended the list of countries from which our importers may expect to receive tobacco containing *Ephestia*. From information received from the Bureau of Entomology, Washington, the origin of the outbreak is not known. The pest was encountered only in stored leaf of the flue-cured variety and was limited to a very small percentage of the tobacco grown in the bright tobacco belt.

Enormous quantities of American tobacco are imported annually into Britain as the following figures show.

In 1928	..	..	..	..	172,343,996 lb.
„ 1929	..	..	..	..	205,279,535 lb.
„ 1930	..	..	..	..	197,657,872 lb.
„ 1931	..	..	..	..	157,188,102 lb.

About 60 per cent. of these quantities are light tobaccos suitable for cigarette manufacture and it is therefore no mean task to maintain an efficient watch over such huge quantities of leaf to see, so far as it is practically possible, that it is free from *Ephestia* before export. Consequently, it is very important that British importers of American tobacco should be continually on the look-out for infested consignments so that they can be segregated or sterilized before the pest has time to do further damage and before it spreads to other tobaccos which may be stored nearby.

In February, 1932, a quantity of Virginian tobacco attacked by *Ephestia* arrived in London from the United States of America. No insects were discovered after a hasty examination but a moderate quantity of frass and webbing was found. Another consignment shipped to Southampton from Newport News, Virginia, in May, 1932, and examined a month afterwards was found damaged by *Ephestia*. Many larvae were discovered in the hogsheads. A consignment of casked bright Virginian tobacco received in London, November, 1932 from Newport News, U.S.A. showed many casks containing *Ephestia* and the leaves were badly damaged. There was much frass and webbing in the leaves.¹

¹Since this report went to press many hogsheads of American tobacco lightly affected by *Ephestia* have been received in London.

(5) Types of Tobacco upon which *Ephestia* has been found

Since the beginning of the investigation *E. elutella* has been found by the writer on the following types of tobacco leaf.

Bright kiln-cured Rhodesian.
Semibright and dark kiln-cured Rhodesian.
Bright kiln-cured Nyasaland.
Rhodesian Turkish air-cured leaf.
Russian Maikop Turkish leaf.
Turkish leaf from Cape of Good Hope.
Turkish leaf from Greece.
Bright American Virginian leaf.

(6) Insects, other than *E. elutella*, found in English Tobacco Warehouses

Insects completing their life-history in cured tobacco.

COLEOPTERA. (Beetles.)

Lasioderma serricorne Fab. (Family—Anobiidae).—A beetle commonly known as the tobacco weevil. All stages have been found in almost all kinds of tobacco. It prefers the better qualities. For a short account of its life-history and the damage done by it see Bovington (1931), or Runner (1919).

Insects found in cured tobacco but not using it as food.

COLEOPTERA. (Beetles.)

Tenebroides mauritanicus L. (Family—Trogositidae).—A cosmopolitan insect occurring in many stored products especially grain. Larvae have been found inside a cask of bright Virginian tobacco also in the "gunny" covering of a bale of fire-cured Nyasaland tobacco. Probably seeking a place for pupation or hibernation. For figure of beetle see Richards and Herford (1930).

Lophocateres pusillus Klug. (Family—Trogositidae).—Cosmopolitan in distribution. Larvae feed on corn, nuts, beans, flour, etc. One or two adults from casks of flue-cured Rhodesian leaf.

Dermestes lardarius L. and *D. vulpinus* F. (Family—Dermestidae).—Insects cosmopolitan in distribution and usually found in animal products such as skins, dried fish, etc. Larvae and adults of

both insects have been found in Tanganyika tobacco. The larvae damage the tobacco by gnawing out recesses in which they metamorphose. O'Mahony (1928) mentions similar damage in a sample of tobacco. Reh (1927) records the insects in a cargo of cigars. *D. vulpinus* was found in stored tobacco by Reko (1930). Figure in Richards and Herford (1930).

Tribolium confusum Duv. and *T. castaneum* Herbst. (Family—Tenebrionidae).—Small insects found frequently in stored products in temperate and tropical countries. Adults have been taken from bales of tobacco from Cape of Good Hope. Figure of *Tribolium castaneum* in Richards and Herford (1930).

Tenebrio molitor L. (Family—Tenebrionidae).—The larva of this beetle is commonly known as the "mealworm" and is found in cereals, flour and flour products in all parts of the world. An adult has been found in a bale of tobacco.

Necrobia rufipes De. G. (Family—Cleridae).—An important pest of copra and cosmopolitan in distribution. Larvae, pupae and adults have been taken from casks of fire-cured, Rhodesian tobacco which had been damaged by contact with copra or with coconut oil during the voyage from E. Africa. Small holes had been eaten in the leaf in which the larvae pupated.

Thaneroclerus girodi Chevrolat. (Family—Cleridae).—Remains of this beetle were found in some bales of Havana, cigar tobacco damaged by *L. serricornis*. Undoubtedly the clerid beetle had preyed upon the latter pest. Hundreds of both *Thaneroclerus* and *Lasioderma* had been wrapped up in silk and killed by spiders, the dead bodies of several of which were found. Much spider webbing inside the bales. For figure, see Runner (1919).

LEPIDOPTERA. (Moths and Butterflies.)

Ephestia cautella Walk. (Family—Phycitidae).—Important pest of dried fruit but feeds also on other raw products. One live adult taken from hessian covering of a bale of fire-cured, Nyasaland tobacco. A dead moth found in an Indian bale.

HYMENOPTERA. (Bees, Wasps, etc.)

Lariophagus distinguendus Kurdj. (Family—Chalcididae).—A small blackish, wasp-like insect parasitising the larvae of *Lasioderma serricorne* and those of certain other beetles. Adults and empty cocoons found in Macedonian tobacco which was badly infested by *Lasioderma*.

Insects found on the floors, walls, etc., of tobacco warehouses.

COLEOPTERA

Niptus hololeucus Fald. (Family—Ptinidae).—A brassy-yellow beetle found feeding on many products and distributed over Europe and North America. These insects are fairly common in warehouses in London and Bristol.

Ptinus fur L. (Family—Ptinidae).—A cosmopolitan insect recorded from many commodities. Found in warehouses in Bristol.

Cryptophagus sp. (Family—Cryptophagidae).—Very small beetles generally distributed in Europe and N. America. A few adults have been found in tobacco warehouses in London and Bristol.

LEPIDOPTERA

Ephestia cautella Walk. (Family—Phycitidae).—Dead adults from warehouses in London.

Borkhausenia pseudospretella Stt. (Family—Oecophoridae).—Cosmopolitan insect often found in houses and feeds on many products. Several adults found in Bristol warehouses.

(7) Depredations of *Ephestia* in Tobacco and how they differ from those of *Lasioderma serricorne*

In some countries *Lasioderma* is a very serious pest of both raw and manufactured tobacco. In Britain, however, unless the leaf is stored in places where the normal temperature is round about 65° F. (18·3° C.) the insect is very inactive and little damage is done. For this reason the insect is not considered to be a very serious pest in England. This is not so with *Ephestia elutella* which breeds well in warehouse and factory under normal English climatic conditions.

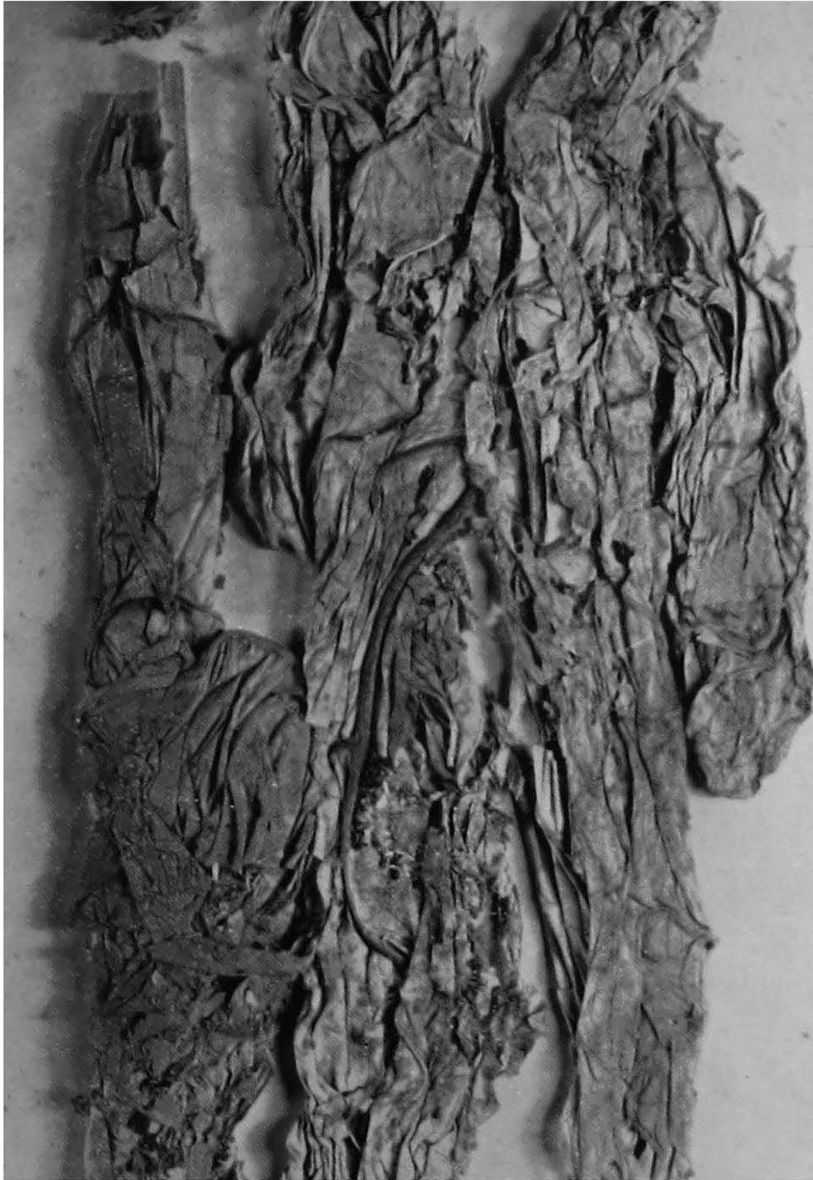


PLATE III. Rhodesian Kiln cured Tobacco leaf showing damage typical of the larva of *Ephestia elutella*.

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PLATE IV. Turkish tobacco damaged by larvæ of *Ephestia elutella*.

This difference in the cold resistance of the two pests makes it imperative that those engaged in the tobacco trade should be able to distinguish between the two insects and between the damages which their immature stages cause.

Where *Ephestia* has been feeding in a "hand" of tobacco one sees irregularly shaped holes together with quantities of dark brown pellets of excrement intermingled with small masses of silk (Plate 3). The pellets are usually of two shades of brown, one end being darker than the other, a character which can easily be recognised by the aid of a low power, hand lens. If a damaged leaf is laid out flat the irregular holes will be seen to be very like those made by a caterpillar in the leaves of a growing plant, and if the damage is at all extensive only the principal veins remain.

On the other hand the perforations made by *Lasioderma* are characteristic of the family Anobiidae to which this insect belongs. The larvae bore cylindrical holes through the leaves in all directions, similar borings being made by the adult in escaping from its pupal cell. Where several galleries meet and cross larger, irregularly-shaped holes may be formed which contain quantities of brown, dust-like frass, the excrement of the "weevil" grubs. Moreover the insect spins no web as *Ephestia* does. No correlation could be found between the infestations of tobacco by *Ephestia* and *Lasioderma*. Much of the tobacco affected by the former was free from the latter and tobacco, in which no trace of *Ephestia* could be discovered, was very often infested by *Lasioderma*.

(8) Life history and Habits of *Ephestia* in the Warehouses

Eggs are laid by the fertilised female moth upon the exterior of bales or casks or upon tobacco exposed through imperfections in the hessian or through cracks and chinks in the wooden case of a hogshead. (In cacao warehouses where the number of moths during the flight season is very high, masses of eggs may sometimes be observed on the outside of the cacao sacks). Any loose tobacco lying about the warehouses may serve as a site for oviposition.

After the egg hatches the young larva for the first few days gnaws at the surface of the tobacco leaf consuming the upper or lower cuticle with the mesophyll lying directly beneath. After the first or second moult it eats through the whole leaf, like other caterpillars, avoiding only the tough veins. It re-acts to the deviations in moisture

content of the tobacco, these deviations being responsible for the state of activity of the larvae which lie dormant when the leaves dry out, and feed and grow rapidly when conditions are at an optimum. Unfortunately, no opportunities have been obtained for making experiments at the docks to ascertain the relationship of moisture content in tobacco to that in the surrounding atmosphere. Probably, small variations in atmospheric humidity occurring over periods of a few hours have very little or no effect even upon the outside leaves of the bales especially as the air surrounding the bales is generally comparatively still. Only the larger variations extending over days are in any way likely to effect noticeable moisture changes in the leaf. The more deeply situated leaf seems immune to all except the larger variations of temperature and humidity which take place over weeks or seasons and, naturally, the compactness of the tobacco has a decided effect on the speed of these changes.

After reaching the fully fed condition, many larvae leave their food-stuff and wander over the exterior of the bales or over the floors and walls of the warehouses, where sometimes hundreds of fully fed larvae have been seen. These larvae ultimately seclude themselves in various crevices and chinks in the buildings or in the folds in the hessian wrappers, spinning cocoons in which they either pupate or lie dormant until the following year. In a badly infested bale scores of these cocoons have at times been found along the seams and in the corners of bales where the edges of the hessian are turned in and sewn together. The pupa is at first dull yellow but as the time approaches for the emergence of the moth the cuticle darkens until it is almost black.

It is improbable that there is more than one major generation annually, although in some favourable places a partial second generation may perhaps be formed. Moths have been captured on the wing in the London warehouses from June to the following January and fully grown larvae from September to May (Table IX). It is possible that the moths flying very early in the season may give rise to a second generation of moths later in the same year, these moths leaving progeny which hibernate as partially or fully developed larvae. But this has not been proved. Moreover, the generations could not be distinguished from one another for it is impossible to say whether captured insects are recent introductions from abroad, or whether they are the offspring of insects which have already passed one or

more generations in the warehouses. Until controlled experiments can be arranged in the actual warehouses, this question of the number of annual generations of *Ephestia* must remain in abeyance.

TABLE VIII.—Months during which larvae and moths have been found in the warehouses

Month.	Moths in Flight.			Larvae in Bales.			Wandering Larvae.		
	1930.	1931.	1932.	1930.	1931.	1932.	1930.	1931.	1932.
Jan.	X	—	—	X	—	—	X	X	X
Feb.	—	—	—	X	X	—	—	—	—
March	—	—	—	—	—	—	—	—	—
April	—	—	—	X	—	—	X	X	—
May	—	—	—	—	—	—	—	X	—
June	X	—	X	—	—	—	—	—	—
July	X	X	X	—	—	—	—	—	—
Aug.	—	—	X	—	—	—	—	—	—
Sept.	X	X	X	X	—	—	X	—	X
Oct.	—	X	X	X	—	—	—	—	—
Nov.	X	X	—	—	—	—	—	X	—
Dec.	X	—	—	—	—	—	X	X	—

Table VIII shows the months during which moths and larvae have been found in the group of warehouses designated "A." The time of the major flight of moths varies slightly from year to year, depending mainly upon the prevailing weather but also upon the situation of the warehouses. It usually occurs in July or August or both. Similarly, most of the wandering larvae have been found in September and October. The observations referring to larvae inside bales were made when opportunity was given for the examination of bales by the owners of the tobacco, but the number of these examinations was not large enough to allow the completion of that section of the table.

(9) Parasites and Diseases of *Ephestia* under Natural Conditions

Microbracon (Habrobracon) hebetor Say. (Figure in Richards and Herford, 1930) a small hymenopterous insect of the family *Braconidae* is a well-known parasite of the larvae of *Ephestia* and *Plodia interpunctella* Hüb., ovipositing on the body of its host upon which the larvae feed. Although thorough searches have been made in the London warehouses no trace of this insect has yet been

discovered, neither has it been reared from *Ephestia* larvae collected there. Yet, a few miles away in the cacao stores, this parasite is quite common and sometimes accounts for a heavy mortality among the fully fed larvae of *E. elutella* (Munro and Thomson, 1929). Mokrzecki (1931) reports that it attacks the larvae of *Ephestia elutella* in tobacco in Poland. *Microbracon* also appears to be common in Southern Rhodesia, where Mossop (1932) has reared as many as thirteen adult parasites from a single *Ephestia* larva. Ustinov (1932) mentions that *Ephestia* in Georgia, S. Russia is kept in check by *M. hebetor* which is particularly numerous in September.

The introduction of *Microbracon* into the tobacco warehouses might serve as a useful adjunct to other forms of control, but before the possibilities of this measure can be seriously considered, a great deal of research work is needed in elucidating the features of the life history and the habits of the parasite under English climatic conditions. No other parasites have yet been found upon *Ephestia* in our tobacco stores.

In the laboratory, *Ephestia* larvae are at times killed by a disease which quickly destroys a whole culture. This disease resembles that caused by *Bacillus thuringiensis* Berliner. (Berliner, 1911, 1915; White, 1927; Zacher, 1927.) Throughout the investigations at the docks no larvae showing the characteristic symptoms—immobility, flaccidness, autolysis and brown to black discolouration—of this disease, have been discovered.

C.—EXPERIMENTAL WORK—ENTOMOLOGICAL

(1) Life History of the moth upon Tobacco under Controlled Conditions

Immediately the present research was begun, as many specimens as possible of the larvae and pupae of *Ephestia elutella* were procured from the docks in order to build up a stock which could be used in experiments. These were kept in glass-topped, metal boxes, 3 in. in diameter and about 1 in. deep, and in a breeding cage of copper gauze on a framework of wood of 12 in. side. All these were kept in a Hearson's biological incubator maintained at a temperature of approximately 26° C. and at a relative humidity which varied between 75 per cent. and 85 per cent.

Since the middle of 1930, screw-topped honey jars, 4½ in. long by 2½ in. diameter, and also larger glass vessels, covered by muslin, have been employed for rearing the insect. These have, on the whole, given better results than the shallow tins previously used.

The incubation period of the eggs was ascertained from observations on forty-eight batches, the time being taken from oviposition to the hatching of the greater number in each batch. The total period occupied by the forty-eight batches was 297 days, which gives 6.2 days as the average period of incubation. In no case was an egg observed to hatch in less than five days. Table IX shows the results of my experiments undertaken to ascertain the duration of the larval stage of the moth. The first part of the table gives the length of the combined egg, larval and pupal stages; the second part gives the duration of the larval stage, assuming six days for the egg and ten for the pupal stage.

TABLE IX.—*Life History of Ephestia elutella Hb.*

Number of days.	Duration of Egg, Larval and Pupal stages.			Duration of Larval stage.		
	Males.	Females.	Total.	Males.	Females.	Total.
21- 30	—	—	—	1	—	1
31- 40	—	—	—	5	2	7
41- 50	2	—	2	5	12	17
51- 60	3	4	7	14	11	25
61- 70	13	11	24	7	14	21
71- 80	12	15	27	3	2	5
81- 90	5	8	13	5	6	11
91-100	2	8	10	2	—	2
101-110	4	1	5	1	1	2
111-120	2	0	2	2	2	4
121-130	1	1	2	—	1	1
131-140	1	2	3	—	1	1
141-150	—	1	1	—	2	2
151-160	—	2	2	2	1	3
161-170	—	2	2	1	1	2
171-180	2	—	2	—	1	1
181-190	1	1	2	3	—	3
191-200	1	1	2	1	1	2
201-210	3	1	4	—	—	—
Total ..	52	58	110	52	58	110

The insects upon which observations were made were bred from eggs obtained in the spring and summer of 1930. It would seem that the duration of the larval stage varies considerably, in some cases extending over a period of six or seven months. This is due to a

dormant phase setting in during which the insect ceases feeding and lies motionless, sometimes within a lightly-made, silken cocoon. One larvae lived 255 days before it pupated.

Insufficient data are available for making conjectures as to the cause of the diapause. It would be advantageous to know exactly the conditions under which it takes place, for this knowledge may have a bearing upon the better breeding of the insect for experimental purposes. It may be that in the warehouses only those larvae hatching late in the season exhibit this dormant period when they hibernate until the following spring. The constant conditions of temperature and humidity usually maintained for laboratory cultures may serve to disturb the normal metabolism of the insect and give rise to the above mentioned protracted diapauses. Mossop (1932) also has records relating to the habit and gives 365 days as the longest larval life he has observed. If one omits from Table IX all those larvae which metamorphosed after 140 days, regarding them as abnormal in behaviour one finds that the average life of male and female larvae under the given conditions is respectively 63.3 days and 65.5 days.

The failure of attempts to induce the insect to produce more than two annual generations in the laboratory rests upon that diapause. Moths obtained from over-wintering larvae have been paired in spring and the resulting eggs have given a second generation of moths. From these a second generation of caterpillars has been obtained but the larvae hibernated during the ensuing winter. Even this success has been obtained on only one or two occasions. Observations on the pupal period were rather scanty as only eight records were taken. These gave an average of 10 days, with 13 and 6 days as the upper and lower limits respectively for that period. Under favourable conditions the time which elapses after the adult becomes free from the pupal case to the time when the wings are ready for use is about 20 minutes. The female is ready to oviposit in 48 hours if she has been fertilized, but egg-laying may be delayed for some days if copulation does not take place.

(2) Experiments in feeding *Ephestia* upon Fire-cured Tobaccos

During the survey of tobacco made in 1929 and the early part of 1930, it was noticed that *Ephestia* appeared to avoid fire-cured, tobacco leaf. Experiments were therefore made to decide if larvae emerging from eggs deposited upon this type of leaf could complete

their development upon it. Pieces of tobacco were placed in glass-topped boxes and a male and female moth introduced into each. The boxes were then placed in the incubator. The results are shown in Table X. In every experiment in which the eggs hatched the larvae died within three days. Bearing in mind the nature of the substances condensed upon the leaf during the curing of these types of tobacco one can conclude that the insects died, either from starvation by declining to consume the leaf, or from poisoning by ingesting the toxic products.

TABLE X.—*Ephestia elutella* Hb. on Fire-cured Tobacco

Experiment.	Tobacco used in Experiment.	Eggs.	Larvae.
A.55	Dark Virginian	Hatched	Died within 3 days
A.59	"	"	"
A.60	"	1 egg hatched	"
A.61	"	Hatched	"
A.68	"	"	"
A.69	"	"	"
A.76	"	"	"
A.77	"	"	"
A.80	"	"	"
A.82	"	"	"
A.83	"	"	"
A.84	"	"	"
A.97	"	"	"
A.100	"	"	"
B.21	Dark Rhodesian	"	"
B.35	Dark Nyasaland	Not hatched	—
B.36	"	Hatched	Died within 3 days.
B.41	"	"	"
B.47	"	"	"
B.48	"	"	"
B.49	"	"	"
B.50	"	"	"
B.55	"	Not hatched	—
B.56	"	Hatched	Died within 3 days.
B.57	Dark Rhodesian	"	"
B.81	Dark Virginian	"	"
C.21	Dark Rhodesian	"	"

(3) Experiments in Food Selection

A series of experiments was devised with a view to determining whether the female moth made any attempt at selection between the bright, flue-cured and the dark, fire-cured types of tobacco when searching for a place to oviposit. A cage about 25 in. long and 3 in.

diameter was made by soldering to the two ends of a piece of copper gauze, bent into the form of a cylinder, two glass-topped, tinned boxes from which the bottoms had been removed. In this way a long cage with detachable ends was formed. It was provided with legs so that it stood horizontally, and into the middle of the top of the cage a smaller, bottomless, glass-topped box was soldered. By removing the lid of this box, moths could be introduced into the experimental cage.

The tobacco, upon which it was intended that the female moth should oviposit, was placed inside on the bottom of the cage. In the early experiments two pieces of tobacco were used, one at each end. For instance, a piece of bright, kiln-cured, Nyasaland tobacco was placed at one end and at the other a piece of dark, fire-cured Nyasaland leaf, of approximately the same dimensions. A male and a female *Ephestia elutella* were introduced and the cage and its contents put into the incubator. In the later experiments two pieces of each type of tobacco were arranged at approximately equal distances along the tube. The position of these pieces were changed in each experiment so as to avoid any possible factor, such as the relative positions of the pieces, from influencing the female in her selection. In each case, unless otherwise mentioned, the pieces were broken directly off the leaf as it came from the bale. Three or four days were allowed for the moth to oviposit and at the termination of this interval the eggs on each piece of tobacco were counted. The results of 22 experiments are shown in Table XI below.

TABLE XI.—*Food Selection Experiments*

Experiment.	Number of eggs laid on kiln-cured Virginia.	Number of eggs laid on fire-cured Virginia.
1	29	11
2	65	5
3	103	50
4	51	12
5	29	0
6	12	3
7	16	1
8	22	24
9	9	29
10	21	43
11	25	26
12	50	0
13	89	9
14	74	25
Total	595	238

TABLE XI.—*Food Selection Experiments*—continued.

Experiment.	Number of eggs laid on kiln-cured Nyasaland.	Number of eggs laid on fire-cured Nyasaland.
1	44	5
2	31	18
3	38	10
4	22	0
5	21	5
Total	156	38
	Number of eggs laid on kiln-cured Rhodesian.	Number of eggs laid on fire-cured Rhodesian.
1	15	0
2	31	10
3	36	0
Total	82	10

In another series of experiments the leaf was stretched over small cardboard boxes so that flat surfaces were presented to the moths. Four boxes were used and the positions of the boxes in the cage altered in each experiment. In three experiments with Nyasaland tobacco, two pieces of kiln-cured and two pieces of fire-cured leaf were used in each case and the results of the experiments were:—

TABLE XII.—*Food Selection Experiments*

Experiment.	Number of eggs laid on kiln-cured Nyasaland.	Number of eggs laid on fire-cured Nyasaland.
1	67	0
2	29	0
3	66	0
Total	162	0

From the above experiments it is evident that *Ephestia elutella* prefers to oviposit upon the kiln-cured tobaccos rather than upon the fire-cured types. In the experiments given in Table XI, only about 25 per cent. of the total number of eggs laid by the moths were deposited upon fire-cured leaf. In the remaining three experiments all were laid on kiln-cured leaf.

The reason for this preference most probably lies in the different methods of curing the two types of leaf. After cutting and wilting, the tobacco leaves or plants are hung in barns. In kiln-curing, heat and smoke generated in furnaces outside the buildings, are conducted through large flues whereby the interior of the barn is raised to the required temperature. The smoke, therefore, does not come into contact with the tobacco. On the other hand, in the fire-curing process, the smoke as well as the heat circulates round the hanging tobacco and many of the volatile products evolved from the burning wood, which is used for fuel, are condensed upon the surface of the leaves. Among the volatile substances are formaldehyde, pyro-ligneous acid (containing methyl alcohol, acetic acid, acetone, methyl acetate, water, etc.), and methyl alcohol, which, besides condensing upon the surface, penetrate into the mesophyll of the leaf. In addition, heavy phenolic bodies of the nature of creosote are also deposited.

These substances are all more or less toxic to insects and are probably responsible for protecting fire-cured tobacco from *Ephestia* damage. It does not appear that the hygroscopicity of these dark tobaccos is a factor contributing to this immunity for, as will be seen from Table XVII, these types of leaf have almost the same capacity for absorbing and giving up water as the kiln-cured types.

Although *Ephestia* does not feed upon fire-cured tobaccos, dark kiln-cured leaf is occasionally damaged and larvae have been taken from bales of this tobacco. Evidence derived from survey work showed that the quantity of infested, bright, kiln-cured leaf was far greater than that of infested, dark tobacco, and it was assumed that the moth selected the former type in preference to the latter for oviposition. With the object of testing this assumption a series of experiments was devised. Unfortunately the number was few but the results (Table XIII) showed that the insect does not sharply

differentiate between the two tobaccos. If this is correct it would appear that larvae arising from eggs deposited upon bright leaf have a greater chance of completing their growth than those on dark leaf. Mokrzecki (1931) states that the better qualities of leaf contain greater quantities of sugars than the lower grades and considers that this is a deciding factor in their greater liability to attack.

The next series of experiments shows that if bright tobacco in good condition is available to *Ephestia* larvae they will consume it in preference to dark tobacco. Known quantities of the two types which had been kept in a dessicator in an atmosphere of 60 per cent. relative humidity were placed in screw-capped jars. A pair of *Ephestia* moths was put into each jar and kept at a constant temperature of 26° C. until eggs had been laid and the resulting larvae were fully grown or had completed their metamorphosis. The leaf was then taken out, cleared from frass, put into the dessicator at 60 per cent. relative humidity for about 10 days and re-weighed. The results are given in Table XIV. In some of those experiments in which the leaf was untouched there is a difference between the original and final weights due to slight variations in the original and final water content, which theoretically should have been equal. These differences in weight are taken into consideration in calculating the quantity of consumed tobacco of the opposite type.

In these food selection experiments it was interesting to note how *Ephestia* prefers to place her eggs in well-protected places, where they and the young larvae are not exposed to dessication. Any chink or depression afforded by the folds and irregularities in the dried leaves of tobacco are utilized and the eggs inserted well into these folds by the extensible ovipositor. Flat surfaces are avoided as was shown by the results of certain experiments in which it was arranged that *Ephestia* could oviposit either upon tobacco broken directly off the "hand" or upon that stretched upon small cardboard boxes. In three experiments in which dark, fire-cured, Rhodesian leaf was used 54 eggs were laid on the stretched leaf and 139 on the unstretched tobacco. Even where the choice lay between stretched, kiln-cured, Nyasaland leaf and unstretched, fire-cured leaf from the same source 75 eggs out of a total of 110 were deposited on the latter in a series of four experiments.

TABLE XIII.—*Food Selection Experiments*

Experiment.	Number of eggs on bright kiln-cured Rhodesian tobacco.	Number of eggs on dark kiln-cured Rhodesian tobacco.
1	21	14
2	35	55
3	130	98
4	95	87
5	78	177
Total	359	431

Experiment.	Number of eggs on bright kiln-cured Nyasaland tobacco.	Number of eggs on dark kiln-cured Nyasaland tobacco.
1	49	79
2	134	11
Total	183	90

TABLE XIV.—*Food Selection Experiments*

Bright Tobacco.			Dark Tobacco.			Remarks.
Original Quantity GMS.	Final Quantity GMS.	Per-centage Eaten.	Original Quantity GMS.	Final Quantity GMS.	Per-centage Eaten.	
11·15	3·01	73·0	13·4	12·39	7·5	Veins and stalks of bright tobacco alone left.
8·56	7·85	7·0	9·66	9·53	—	Dark tobacco untouched.
9·55	7·76	18·8	14·4	13·8	4·1	Dark tobacco untouched.
4·22	3·69	13·3	3·88	3·91	—	Dark tobacco untouched.
5·80	5·46	5·9	7·9	7·8	1·3	Dark leaf slightly eaten.
7·60	7·03	7·5	8·77	8·65	1·4	Dark leaf slightly eaten.
3·47	3·54	—	3·95	3·97	—	No eggs developed.
4·95	3·13	36·8	5·4	5·4	—	Dark tobacco untouched.
5·23	5·21	—	3·41	3·47	—	No eggs developed.
6·0	3·74	36·7	4·08	4·03	—	Dark tobacco untouched.
6·8	5·96	11·76	4·15	4·12	—	Dark tobacco untouched.
6·45	5·98	6·7	6·83	6·78	—	Dark tobacco untouched.
3·1	3·13	—	2·22	2·00	9·9	Bright tobacco untouched, mouldy.
3·13	2·85	9·0	2·98	2·08	30·2	Bright tobacco mouldy.

In the first eleven experiments the tobacco used was Rhodesian ; in the rest, Nyasaland.

(4) The Subsistence of young Larvae on Hessian

It has been suggested several times that the hessian wrapper of bales was the real object sought by *Ephestia*. It was surmised that the insect first of all attacked the jute fabric and then passed on to the tobacco beneath. No record has been found of larvae feeding upon fabric of any description and it was almost certain that this idea was quite without foundation. Starch is the only substance besides oil normally found on manufactured hessian. Two samples of hessian which is normally used in baling tobacco were tested at The Imperial Institute, London, and were found to contain 1.0 per cent. and 1.1 per cent. of starch respectively. One could scarcely imagine that the larvae of *Ephestia* could subsist on that amount of starch in hessian nor would it serve to attract the moths.

To test whether the young larvae could develop on hessian alone a number of experiments were arranged. Pieces of the two samples of hessian were enclosed in glass jars, each with a pair of *Ephestia* adults and the jars placed in the incubator at 26° C. Seven experiments were made with each sample and eggs were laid in all jars containing sample "A" and in 6 containing sample "B". The greater number of eggs hatched and the young larvae wandered about over the hessian, but in no instance was the fabric seen to be damaged to the least extent. In most cases the larvae died in one or two days. The remaining larvae fed upon the dead bodies of their parents and succumbed after consuming all the softer parts.

(5) Experiments in feeding other Phycitid Moths upon Tobacco

Having found one or two specimens of *Ephestia cautella* Walk. in the warehouses at the docks, it was thought that this moth and possibly other closely related Phycitid moths infesting stored products, would also be capable of passing their life history upon tobacco. Attempts were made to feed *Ephestia cautella* Walk., *Ephestia kuhniella* Zell. and *Plodia interpunctella* Hb. upon the same kinds of tobacco upon which *Ephestia elutella* Hb. thrived. A negative result was obtained in all the experiments.

D.—EXPERIMENTS BEARING UPON METHODS OF CONTROL

(1) The Reconditioning of Tobacco and its Effects upon *Ephestia*

Tobacco as received in a factory from the warehouses is very often too brittle to be handled without its crumbling to dust. In modern factories, the leaf, as it leaves the bale or cask, is passed through a reconditioning machine where it is subjected to the action of steam. In this process the tobacco absorbs moisture and is rendered very pliable and easy to handle. In smaller establishments the same end is obtained by damping the tobacco with water and allowing sufficient time for the moisture to be absorbed. If all tobacco as it enters a factory is passed through a reconditioning machine—and it is known that tobacco so treated is free from living *Ephestia*—one would infer that any infestation subsequently found in the manufactured tobacco had originated either during or after its manufacture.

In one or two instances larvae and pupae of *Ephestia elutella* have been discovered in cigarettes manufactured in England since 1929. It was therefore of interest to study the effects of the passage of *Ephestia* eggs through a reconditioning machine as used in a large factory. The results of a number of experiments proved that the eggs are destroyed in the process. The eggs were placed on small pieces of tobacco leaf, the leaf being then folded over and put into small muslin bags so that no eggs should be lost. These bags were distributed over the endless band which conveyed the tobacco through the steam, most of them being placed between the leaves of the "hands" so that the eggs were as well-protected as well-concealed eggs are when deposited under natural conditions. The time taken for the eggs to pass through the machine was 10 minutes. Each batch of eggs used was compared with a control batch laid by the same female moth and each control received the same treatment as the corresponding experimental batch except the passage through the machine. Table XV shows the results of the experiments.

TABLE XV.—Eggs of *Ephestia elutella* in the Reconditioning Machine

No. of bag.	Date on which eggs were laid.	Date eggs were put into bag.	Date eggs were put into machine.	Controls.			Experiments.			Remarks.
				Dead.	Alive.	Total.	Dead.	Alive.	Total.	
B.24	26/27.3.30	27.3.30	27.3.30	1 lost	34	35	37	—	37	Not fertilized.
B.25	26/27.3.30	27.3.30	27.3.30	24 shrivelled.	—	24	29	—	29	
A.99	26/27.3.30	27.3.30	27.3.30	1 shrivelled.	28	29	27	—	27	Examined 2.4.30.
A.89	26/27.3.30	27.3.30	27.3.30	2 lost	19	21	24	—	24	
A.93	26/27.3.30	27.3.30	27.3.30	—	37	37	35	—	35	
A.96	26/27.3.30	27.3.30	27.3.30	—	21	21	19	—	19	
A.90	26/27.3.30	27.3.30	27.3.30	2 lost	18	20	23	—	23	
A.95	26/27.3.30	27.3.30	27.3.30	—	25	25	27	—	27	
A.86	26/27.3.30	27.3.30	27.3.30	—	29	29	27	—	27	
A.95	10/11.3.30	11.3.30	12.3.30	—	17	17	19	—	19	
A.99	10/11.3.30	11.3.30	12.3.30	1	29	30	30	—	30	
A.96	10/11.3.30	11.3.30	12.3.30	—	36	36	35	—	35	
A.86	10/11.3.30	11.3.30	12.3.30	—	21	21	21	—	21	Examined 17.3.30.
A.93	10/11.3.30	11.3.30	12.3.30	—	16	16	17	—	17	
A.90	10/11.3.30	11.3.30	12.3.30	—	23	23	21	—	21	
A.89	10/11.3.30	11.3.30	12.3.30	1 lost	31	32	29	—	29	

These results show that *Ephestia* eggs are destroyed by 10 minutes' treatment in a reconditioning machine in which the temperature reached is well over 70° C. Noyes (1930) determined that at a temperature of 70° C. exposed larvae and pupae of *Ephestia elutella* were killed in 10 minutes and exposed eggs in 30 minutes. The imago is usually less resistant to physiological disturbance by heat or cold than any of the other stages in the life history of moths. Although no experiments have been made upon *Ephestia* adults to prove this, one may say that moths subjected to the above treatment will be destroyed. Moreover, as the tobacco "hands" are being pulled apart before being placed in the machine, the moths are most likely to be disturbed and driven to flight. It may therefore be concluded that tobacco reconditioned by live steam as above described will be free from *Ephestia*. Mokrzecki (1931) writes that larvae in tobacco bales can be killed in 5 minutes by hot air at 64° C. if the bales are opened and the air be allowed to penetrate the mass of tobacco.

(2) Vacuum Fumigation with Ethylene Oxide

In March, 1932, an experiment in the fumigation by ethylene oxide of three bales of Rhodesian tobacco infested by *Ephestia* was carried out in an experimental fumigation plant. This plant consisted of a horizontal, welded steel cylinder with a door at one end which could be hermetically sealed and the chamber evacuated by a Pfeiffer vacuum pump mounted beneath the cylinder. Ethylene oxide, generated in a small separate apparatus by the action of chlorhydrin upon sodium hydroxide, was conducted to the chamber through an electrically operated heater and a water trap. The chamber was heated by a steam coil mounted in the upper part of the cylinder and its internal temperature measured by a mercury-in-steel thermometer. The pressure inside the chamber was given by a recording manometer attached to the outside.

In preparation for fumigation the chamber was heated to a pre-determined degree and the tobacco bale placed inside. The required amounts of chlorhydrin and sodium hydroxide were then placed in the gas generator. The chamber was exhausted of air, the pump stopped and the chlorhydrin allowed to run over the caustic soda. The ethylene oxide evolved during the reaction flowed over into the exhausted cylinder until the manometer indicated a steady pressure. Carbon dioxide from a gas cylinder was then admitted to the chamber until the pressure inside reached that of the atmosphere. After the required time of fumigation the vacuum in the cylinder was again established. Air ports at the side of the cylinder were next opened and the residual gases washed out by a stream of air maintained by the action of the pump for about 10 minutes. The bale was finally removed from the chamber and stowed away for a time in Liverpool before being examined for live larvae.

Besides the *Ephestia* larvae in the bales, other insects, contained in small tins—the details of which are given below—were put in various positions inside the bales, and also on the floor of the fumigation chamber. Controls were used for each batch of experimental insects, the percentage hatching from these controls being normal values except that of the eggs of *E. kühniella*. For some reason the mortality among these eggs was very high, namely, just over 90 per cent.

1st Fumigation :—

Period allowed for fumigation : 3 hours 6 minutes.
Pressure registered at 1st vacuum : 28·0" Hg.
Average maximum temperature of chamber during
fumigation : 38·4° C.
Maximum temperature at centre of bale : 20·5° C.
Partial pressure of ethylene oxide : about 2" Hg.
" " carbon dioxide : about 28" Hg.
Pressure registered at 2nd vacuum : 29·8" Hg.

Supplementary insects used in the experiment :—20 adults of *Lasioderma serricorne*; 40 adults of *Calandra oryzae*; 20 pupae of *E. kühniella*; 40 larvae of *Trogoderma granarium*; 20 larvae of *Tenebrio molitor*; 10 larvae of *Tribolium* sp.; 10 larvae of *Plodia interpunctella*; 537 eggs of *E. kühniella*. None of these insects survived the fumigation.

2nd Fumigation :—

Period allowed for fumigation : 2 hours.
Pressure registered at 1st vacuum : 29·7" Hg.
Average maximum temperature of chamber during
fumigation : 43·8° C.
Maximum temperature at centre of bale : 17·5° C.
Partial pressure of ethylene oxide : about 6" Hg.
" " carbon dioxide : about 24" Hg.
Pressure registered at 2nd vacuum : 29·8" Hg.

Supplementary insects used in the experiment :—20 adults *Lasioderma serricorne*; 4 adults of *Calandra oryzae*; 40 larvae of *Trogoderma granarium*; 10 larvae of *Tribolium* sp.; 20 larvae of *Tenebrio molitor*; 566 eggs of *E. kühniella*. All these insects were killed, except three *Ephestia* eggs, which hatched after 1 or 2 days' incubation at 26° C.

3rd Fumigation :—

Period allowed for fumigation : 3 hours 54 minutes.
Pressure registered at 1st vacuum : 29·8" Hg.
Average maximum temperature of chamber during
fumigation : 39·8° C.
Maximum temperature at centre of bale : 16·65° C.
Partial pressure of ethylene oxide : 5·5" Hg.
" " carbon dioxide : 24·5" Hg.
Pressure registered at final vacuum : 30·1" Hg.

Supplementary insects used in the experiment :—20 adults *Lasioderma serricorne*; 40 adults of *Calandra oryzae*; 20 pupae of *E. kühniella*; 40 larvae of *Trogoderma granarium*; 10 larvae of *Tribolium* sp.; 20 larvae of *Tenebrio molitor*; 181 eggs of *E. kühniella*. None of these insects survived the test. All the *Ephestia* larvae originally in the three bales were reported killed.

During the 1st fumigation, determinations of the concentration of ethylene oxide in the chamber were made and the following results obtained. Table XVI.

TABLE XVI.—*Determinations of Ethylene Oxide*

Sample taken from	Time after admission of oxide.	Concentration (mgs. per litre).
	minutes.	
Top of chamber	30	—
	60	30.7
	120	29.0
	180	27.4
Bottom of chamber	30	32.1
	60	28.1
	120	28.3
	180	26.9
Middle of tobacco bale ..	30	12.4
	60	9.6
	120	9.9
	180	10.0

The concentration of ethylene oxide in the middle of the bale was about one-third of that in the rest of the chamber. This is probably due to its ready absorption by the tobacco, an action which may also account for the steady reduction in concentration in the chamber. Slow diffusion is probably the cause of the slight increase which subsequently takes place in the bale. One determination was made of the quantity of ethylene chlorhydrin carried over by the ethylene oxide. This amounted to 3.6 mgs. per litre.

(3) Effects of Low Temperature on *Ephestia*

The following account contains the results of a series of experiments undertaken to ascertain the resistance of the moths *E. kühniella* and

E. elutella to low temperatures. The experiments form a part of another more comprehensive investigation into the periods for which tobacco must be held in cold storage to free them from *E. elutella*.

The scarcity of *E. elutella* in the warehouses, except for about three months during the summer of each year, has necessitated the main part of these experiments being made upon the closely related moth *E. kühniella*, which can be bred in large numbers in the laboratory throughout the year. Consequently, as was anticipated, from the comparatively few eggs of the former insect procured, working single-handed, only a skeleton series of tests on that insect could be completed. It was therefore considered that, by running a parallel series of experiments on *E. kühniella* and using a much larger number of eggs, a fairly thorough knowledge of its cold resistance would be obtained and one could, by comparison and deduction, make a wider application of the results of the less complete study on *E. elutella*. The number of eggs of *E. kühniella* and *E. elutella* used were respectively 198,000 and 21,310.

Eggs were obtained by enclosing copulating pairs of moths in small cardboard boxes and separating out the eggs deposited after intervals of 24 hours until the death of the female. The eggs from a number of these pairs were mixed together and divided into two portions, one for experiment and one for control. Each batch was placed in a small glass tube bearing a reference number and the tube plugged with cotton wool. The tubes were then put into the refrigerator for definite times. After removal from the refrigerator the eggs were incubated at 26° C. for at least seven days, at intervals during which the hatched larvae were counted and separated from the unhatched eggs. The remainder were dead eggs. The controls remained in the incubator from the beginning of the experiment and the percentage hatch computed in the same manner.

The larvae used in these low temperature experiments were obtained from those controls. After being separated out they were fed upon wholemeal flour and kept at 26° C. until a definite age was reached. They were then divided into experimentals and controls, placed in tubes in the same way as the eggs and subjected to the reduced temperatures for definite times. The pupae and imagos were taken from mass cultures and were of undetermined ages. Experimental and control batches were used as with the eggs. During those experiments included in the notes below the temperature of the refrigerator did not vary outside the limits given.

It will be noticed that *E. elutella* shows a lower resistance to reduced temperatures than *E. kühniella*, and it is probable that this difference in the resistance of the insects will be found to apply throughout the whole series of experiments when it is completed. At each of the four temperatures employed, only those results showing the periods required to inflict 100 per cent. mortality are given, together with the percentage kills obtained when the insect was exposed to the given temperature for a period just below that upper limit.

Experiments at - 3 to - 4° C.

E. kühniella :—

Eggs—

Number of eggs used : Experimentals, 17,467 ; Controls, 4,896.

None hatched at 336 hours.

Eggs of average age—

12 hours :	0.23	per cent.	survived	after	168	hours.
36 " :	0.36	" "	" "	" "	264	"
60 " :	0.68	" "	" "	" "	168	"
84 " :	89.6	" "	" "	" "	72	"

Larvae—

No larvae (7 to 8 days old) alive at or after 168 hours.

Some (36 days old—dormant larvae) alive after 145 hours.

Pupae—

None alive at or after 215 hours.

Adults—

Some alive after 23.75 hours.

E. elutella :—

Eggs—

Number of eggs used: Experimentals, 2,401; Controls, 264.

None alive at or after 168 hours.

Eggs of average age—

12 hours :	0.0	per cent.	hatched	at	95.75	hours.
36 " :	0.0	" "	" "	" "	95.75	"
60 " :	0.65	" "	" "	" "	95.75	"

Larvae—

None survived at or after 95.57 hours.

Pupae—

No experiments made.

Adults—

No experiments made.

Experiments at - 6 to - 7° C.

E. kühniella :—

Eggs—

Number of eggs used : Experimentals, 50,582 ; Controls, 27,292.

None hatched at or after 264 hours.

Eggs of average age—

12 hours : 0·6 per cent. hatched after 263·6 hours.

36 " : 0·3 " " " " 263·6 "

60 " : 0·19 " " " " 263·6 "

84 " : 0·0 " " " " 263·6 "

Larvae—

None survived at or after 188 hours.

Some (age 37-43 days) survived after 143·8 hours.

Pupae—

None alive at or after 235·4 hours.

Some alive after 186·8 hours.

Adults—

None used in the experiments.

E. elutella :—

Eggs—

Number of eggs used : Experimentals, 3,306 ; Controls, 2,181.

None hatched at or after 167·9 hours.

Some hatched after 94·6 hours.

Larvae—

Dormant larvae alive after 91·6 hours.

Larvae (found wandering in cacao warehouses) alive at 51·25 hours.

Larvae (age 11-12 days) dead at 49·25 hours.

Pupae—

None used in experiments.

Adults—

None used in experiments.

Experiments at — 10 to — 11° C.

E. kühniella :—

Eggs—

Number of eggs used : Experimentals, 41,104 ; Controls, 18,628.

None hatched at or after 75·2 hours.

Eggs of average age—

12 hours : 0·94 per cent hatched after 72·5 hours.

36 " : 0·49 " " " " 71·6 "

60 " : 2·12 " " " " 70·0 "

84 " : 0·0 " " " " 50·0 "

Larvae—

None survived at or after 18 hours.

Some (age 29–33 days) survived after 6·4 hours.

Pupae—

All dead at and after 44 hours.

Some alive at 43 hours.

Adults—

None survived after 1·75 hours.

E. elutella :—

Eggs—

Number of eggs used : Experimentals, 2,826 ; Controls, 850.

None hatched after 18 hours.

Eggs of average age—

12 hours : 0·4 per cent. hatched after 17·9 hours.

36 " : 0·34 " " " " 5·4 "

60 " : 4·8 " " " " 5·4 "

Larvae—

None lived at or after 5·8 hours.

Some (23 days old) survived after 4·25 hours.

Pupae—

None used in experiments.

Adults—

None used in experiments.

Experiments at — 15 to — 16° C.

E. kühniella :—

Eggs—

Number of eggs used : Experimentals, 29,547 ; Controls, 8,862.

None survived at or after 60 hours.

Eggs of average age—

12 hours : 4.0 per cent. survived after 17.8 hours.

36 " : 1.23 " " " " 24.3 "

60 " : 0.19 " " " " 26.0 "

84 " : 4.2 " " " " 4.6 "

Larvae—

Some alive after 25.6 hours.

Pupae—

None alive at 43.75 hours.

Some alive at 28.5 hours.

Adults—

None used in the experiments.

E. elutella :—

Eggs—

Number of eggs used : Experimentals, 7,573 ; Controls, 1,959.

None survived at or after 12 hours.

Eggs of average age—

12 hours : 5.18 per cent. hatched at between 1 and 4.9 hours.

36 hours : 0.0 per cent. hatched at between 1 and 4.9 hours.

60 hours : 0.49 per cent. hatched at between 1 and 4.9 hours.

Larvae—

All dead at or after 1 hour.

Some (19–21 days) alive at 0.5 hours.

Pupae—

None used in experiments.

Adults—

None used in experiments.

(4) Experiments on the Rate of Cooling of Tobacco in Cold Storage

The preceding experiments were made upon eggs contained in small glass tubes. To utilise the results of those experiments in the commercial freezing of tobacco against *Ephesia* one must know the rate of heat conduction through bales and casks. A description of the tests made to ascertain this rate follows. By kind permission of the directors of the South London Cold Stores and of the Imperial Cold Stores, the first four experiments were made on a bale of Southern Rhodesian, unstemmed, flue-cured tobacco, the dimensions of which were $2\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft., and the weight about 220 lb.

The temperature of the bale was measured by the use of a thermocouple constructed from copper and constantin (an alloy of nickel 45 per cent., and copper, 55 per cent.) wires mounted on a long malacca cane, which could be pushed into the bale. The other junction was immersed in a large jar of alcohol. The differences in temperature between the two junctions produced thermal E.M.Fs., which were measured by a delicate galvanometer calibrated to convert its arbitrary readings into differences of temperature. The figures along the curves in Graphs I to IV (Figs. 1 to 4) indicate the depth in the bale at which the various observations were taken. The two separate curves in full line join observations taken at the same depth and the first curve is completed by continuing it as a dot and dash line until it touches the second curve at the point where the temperature of the room is equal to that existing throughout the interior of the bale.

Experiment I

The bale was placed in a cold chamber of about 1,500 cub. ft. capacity where the daily fluctuations of temperature were between -12° C. and -15.5° C. The chamber was almost full of stores undergoing freezing and was cooled by circulating brine without an artificial circulation of air.

It will be seen from Graph I, Fig. 1, that the final temperature of the bale was higher than the normal average for the room. This was due to the shutting off of the cooling plant during the week-end. Had the normal fluctuations of temperature continued during the latter part of the experiment another one or two days would have been necessary for the bale to reach -13.5° C., which is taken as the average temperature of the room. However, one can employ the results of experiment III to ascertain approximately the course

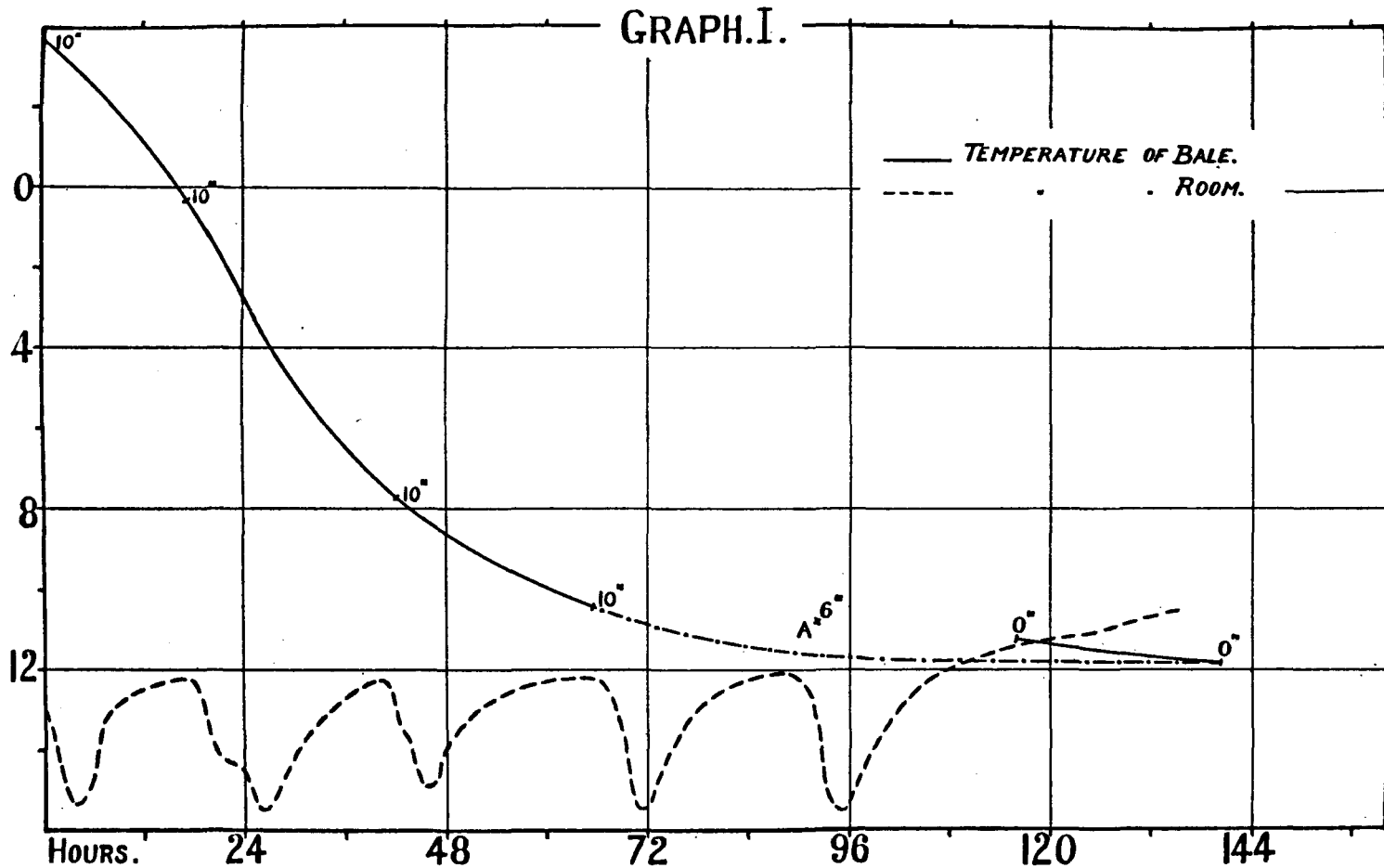


FIG. I. Cooling Curve for a bale of tobacco. See Experiment I page 54

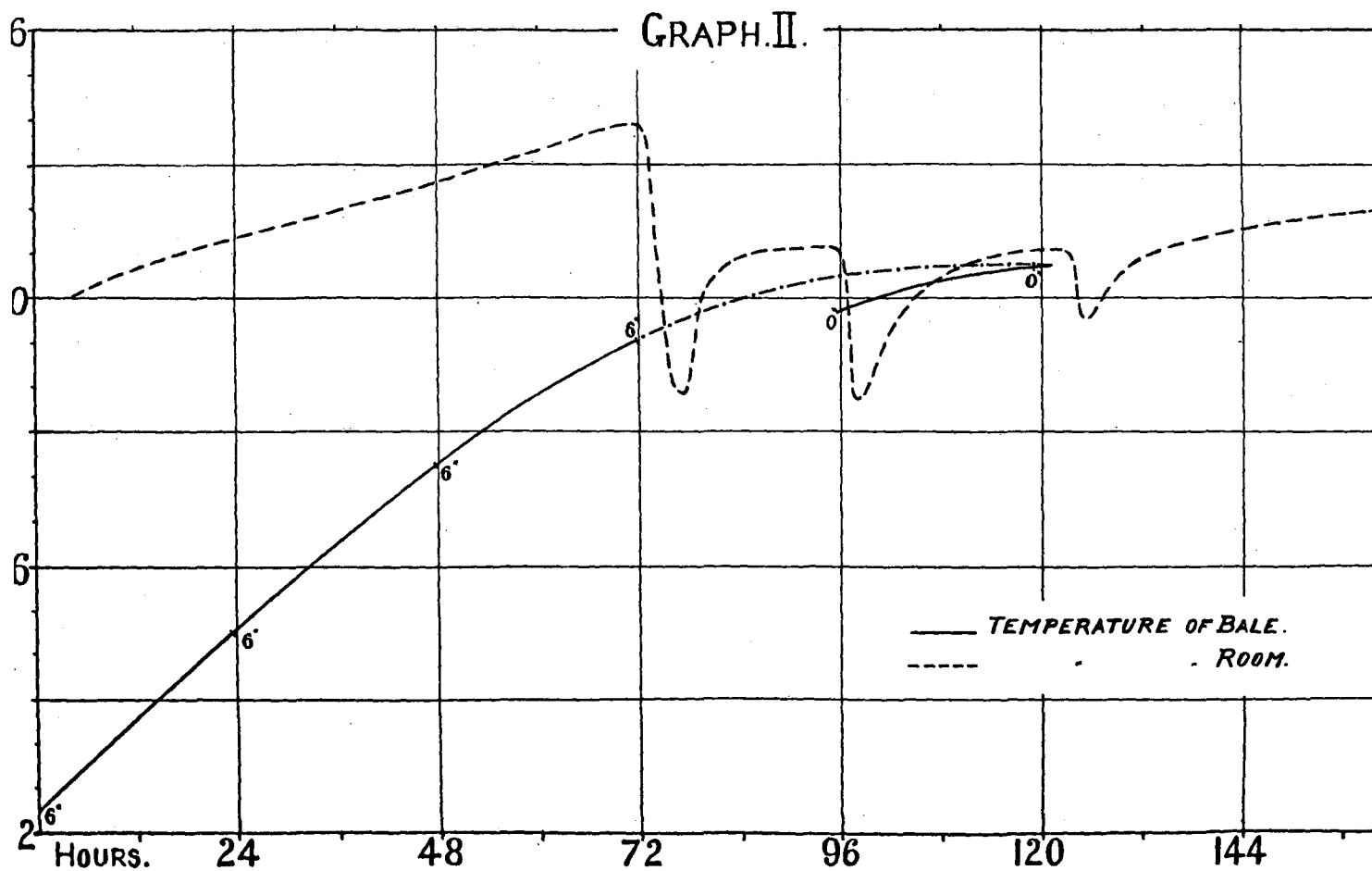


FIG. 2. Heating Curve for a bale of tobacco. See Experiment II, page 55.

GRAPH. III.

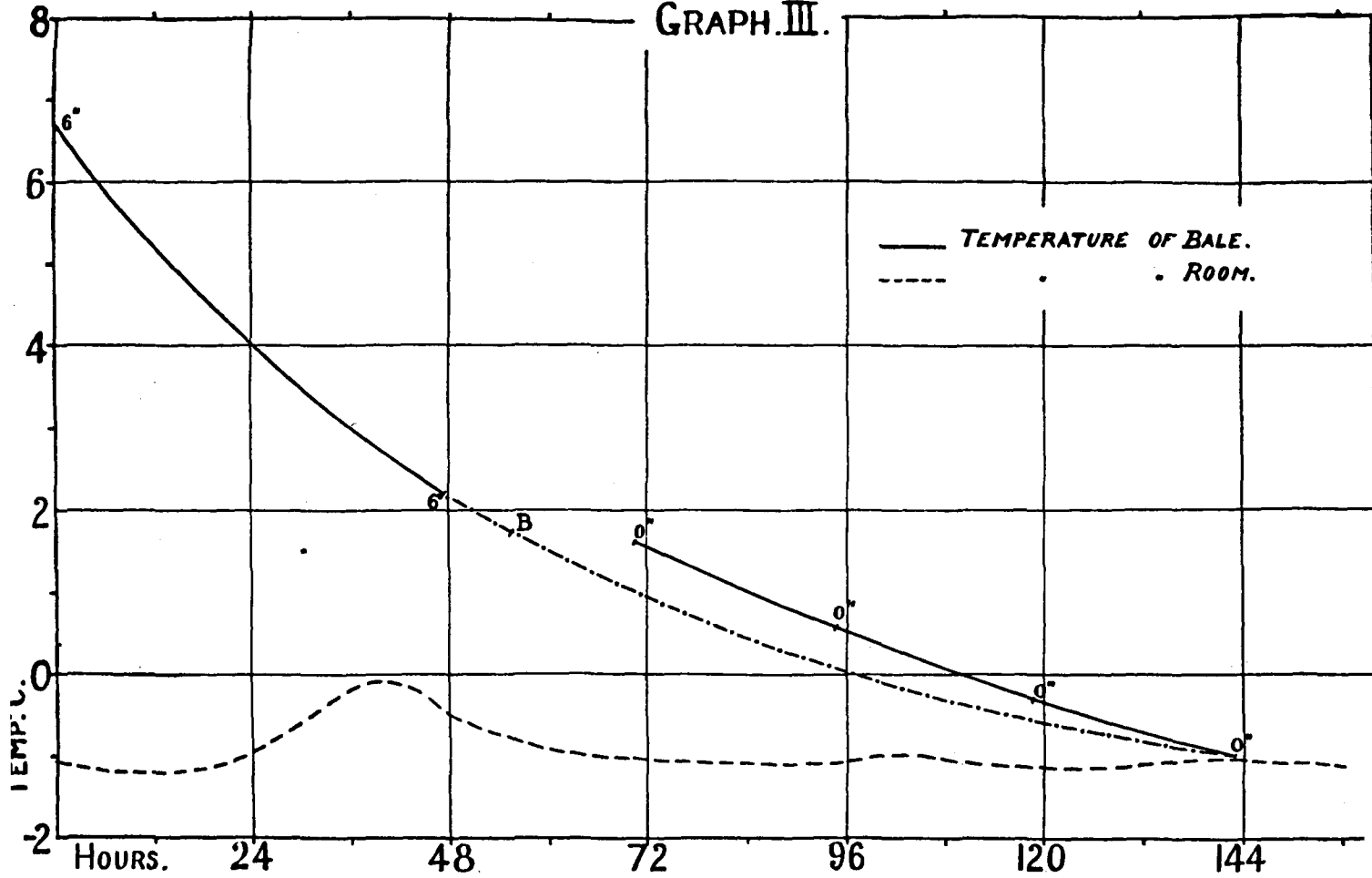


FIG. 3. Cooling Curve for a bale of tobacco. See Experiment III, page 55.

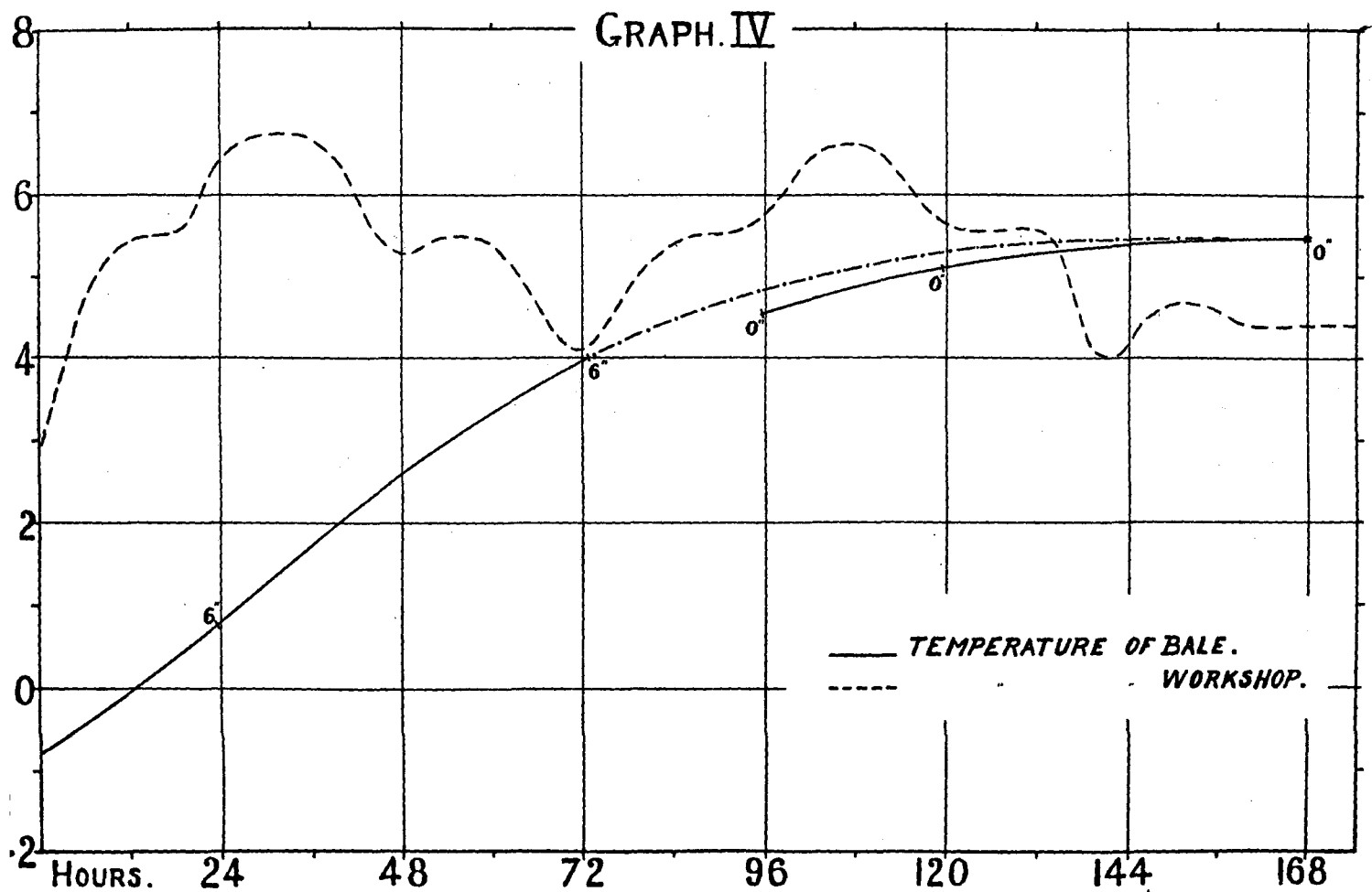


FIG. 4. Heating Curve for a bale of tobacco. See Experiment IV, page 55.

of the last portion of the curve in Graph I, assuming the normal variations in temperature to have continued throughout the experiment. In experiment III the temperature of the chamber is more even and the final temperature of the bale was that of the normal for the room. As in experiment I no forced air circulation was employed.

Point A in Graph I is a temperature reading taken at 6 in. from the centre of the bale when the chamber was at a normal temperature of -13.5°C . This means that after 91 hours the temperature of the bale at a point 6 in. from its centre was 2.75° above that of the chamber. The corresponding point in Graph III, Fig. 3, is marked B, and the time taken for the bale to cool from this point to -1°C , the normal temperature of the room, is $144 - 56$ hours = 88 hours. Therefore we may assume that a further 88 hours is required after point A in the first experiment is reached, for the bale to take up a temperature of -13.5°C . Thus 91 and $88 = 179$ hours. Hence for the cooling of the bale from 3.5°C . to -13.5°C . requires 179 hours or about 7.5 days.

Experiment II

Directly after experiment I the bale was put into an empty cool room of about 2,400 cub. ft. capacity and thawed out. The temperature of the room fluctuated as shown in Graph II (Fig. 2), an artificial circulation of air being maintained whilst the cooling plant was running. For a rise in the temperature of the bale of 12.25°C . a period of 120 hours or 5 days was needed.

Experiment III

After allowing the bale to return to normal temperature it was placed in a large, cold room having a capacity of over 39,000 cub. ft. At the time of the experiment the room was about half full of hops. There was no artificial circulation of air and the temperature was maintained at about -1°C . Under an average temperature gradient of 3.8°C . the bale cooled 7.6°C . in 144 hours. Graph III, Fig. 3, gives the data obtained in the experiment.

Experiment IV

On the completion of experiment III the bale was removed to an adjoining workshop to allow it to return to normal temperature. The capacity of the workshop was not determined. The temperature of the bale rose 6.25°C . in about 156 hours ($6\frac{1}{2}$ days) under an average temperature gradient of about 3.1°C . as shown in Graph IV (Fig. 4).

The director of the International Cold Storage and Ice Co., Ltd., Southampton, has kindly given his permission to publish the particulars of his experiments on the rate of cooling of tobacco in bales, casks and hogsheads. The results of those experiments are given below.

Experiment V

In March 1932, a bale of Rhodesian tobacco of the usual dimensions was placed in cold storage together with 40 hogsheads of tobacco. Graph V (Fig. 5) shows the course of the temperature changes in the room and at the centre of the bale. The room temperature curve is drawn through the mean values of the maximum and minimum temperature for each day.

Approximately 11 days were necessary for the bale to attain the average temperature of the room. The fall of temperature at the centre of the bale was 35° F. (19·4° C.) whilst that in the room was about 22° F. (12·2° C.). The cause of the temperature fluctuations inside the bale from the 12th to the 24th day of storage could not be unravelled from the pen tracings on the circular chart of the thermograph, but the final temperature of the bale when taken out of the room was 4° F. (−15·6° C.). (Figure B on graph). The break in the curve for room temperature was due to the temperature falling so low that the pointer of the thermograph went off the chart, and the minimum could not be determined. Point A in that curve indicates the stowing of another 50 hogsheads.

Experiment VI

Graph VI (Fig. 6) shows the fall in temperature in one of 107 hogsheads of tobacco placed in a cold room of 21,000 cub. ft. capacity and cooled by direct expansion of ammonia. The temperature of the bale was taken by a thermograph placed at a depth of 20 in. A drop in temperature of 58° F. (32·2° C.) in 20 days was recorded.

Experiment VII

This experiment was made on a case of tobacco leaf measuring 4 ft. by 2 ft. 8 in. by 2 ft. 8 in. As shown in Graph VII (Fig. 7) approximately 9 days storage was required to reduce the temperature of the tobacco from 45° F. (7·2° C.) to 10·0° F. (−13·3° C.), which was just above the average temperature of the room. After the first two days the latter temperature was fairly constant.

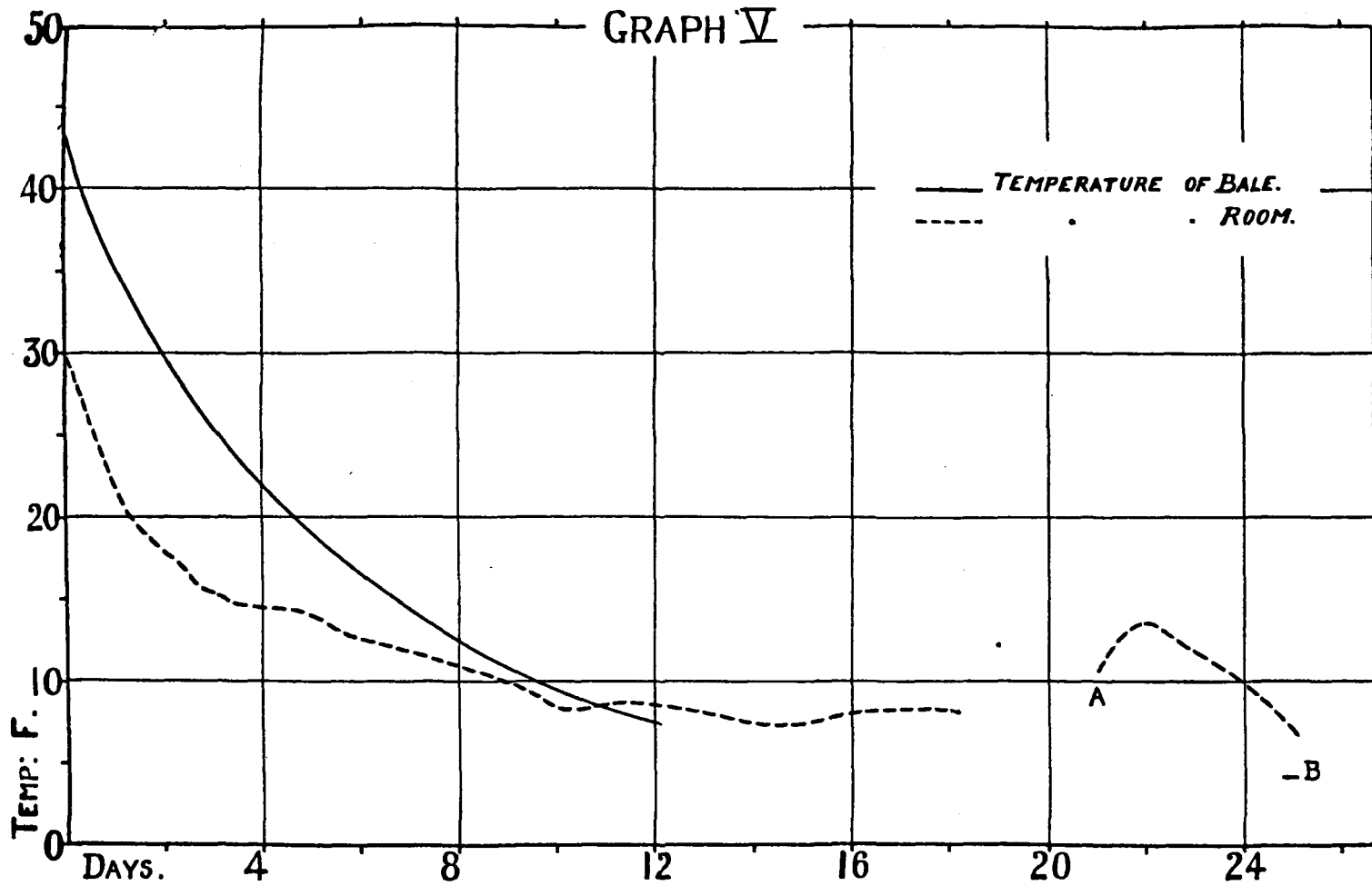


FIG.5. Cooling Curve for a bale of tobacco. See Experiment V, page 56.

GRAPH. VI

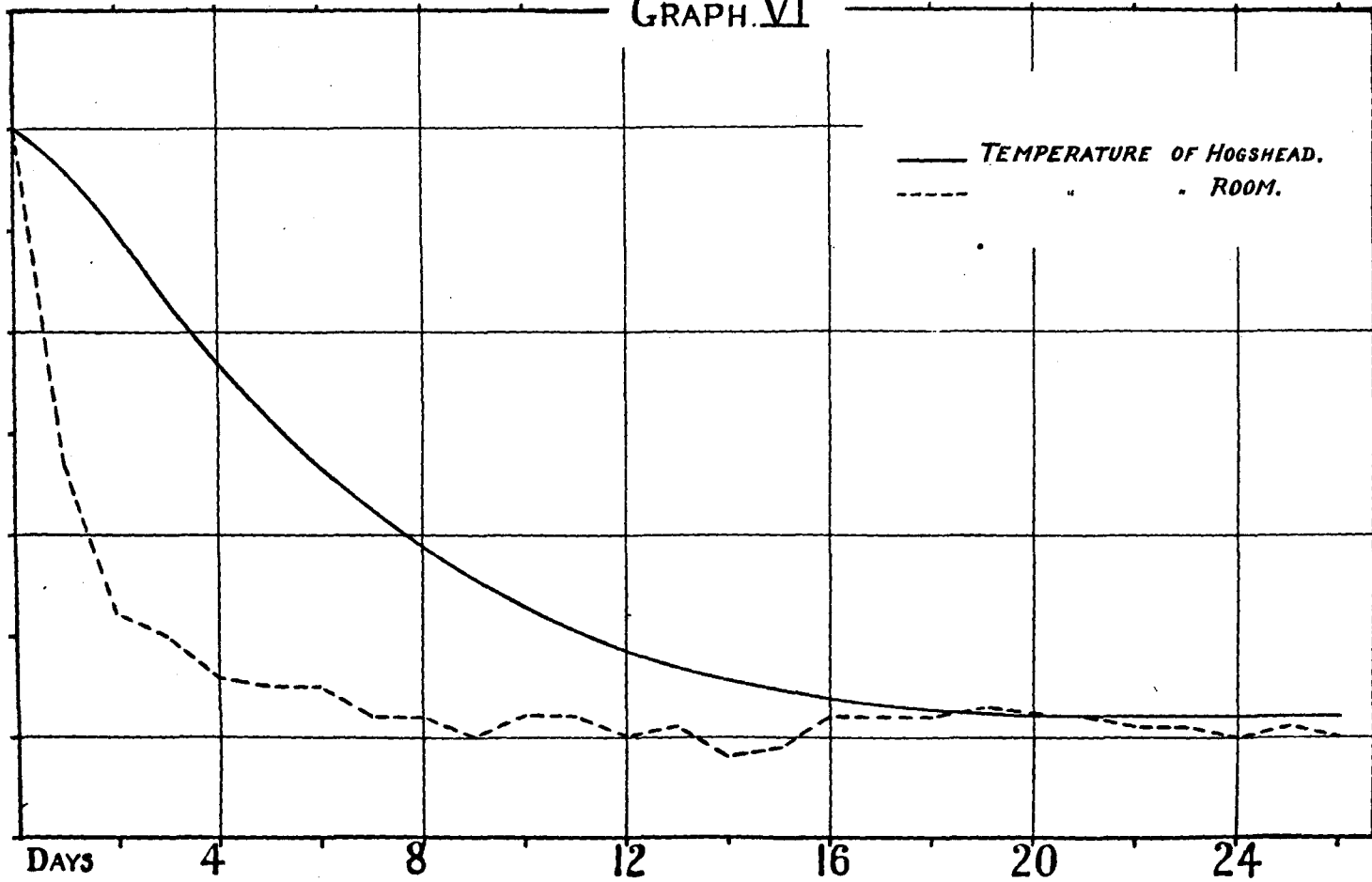


FIG 6 Cooling Curve for a Hoghead of tobacco. See Experiment page 56

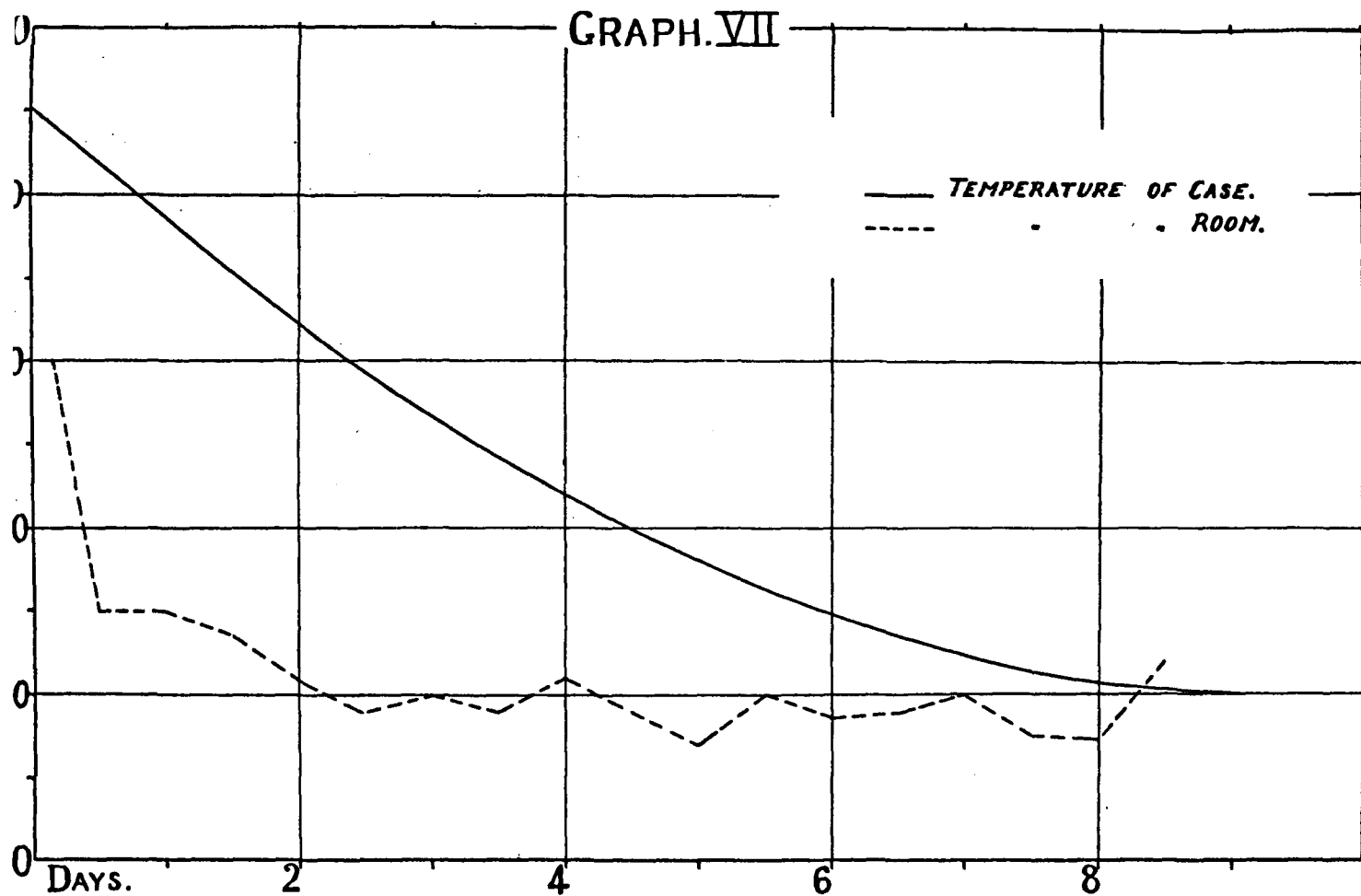


FIG.7. Cooling Curve for a Case of Tobacco. See Experiment VII. Page 56.

Experiment VIII

The results of this experiment were kindly supplied by The Imperial Tobacco Co., Ltd. A number of hogsheads of tobacco were put into cold store the average temperature of which was about 5° F. (— 15° C.) throughout the test. In one hogshead the temperature at the centre was reduced from 55° F. (12·8° C.) to 6·5° F. (— 14·2° C.) in 23 days. In another a drop of 39° F. (21·7° C.) to 7° F. (— 13·9° C.) was recorded in 17 days.

(5) Reaction of Tobacco to Changes in Atmospheric Humidity

In the late summer of 1929, the tobacco merchants thought that the excessive damage done to Rhodesian tobacco was in some way correlated with its hygroscopic properties. They supposed that it imbibed more moisture than other tobaccos placed under identical conditions. The idea, however, had to be abandoned very soon afterwards when it was discovered that other types of leaf were as readily liable to infestation as Rhodesian Virginian tobacco. Table XVII shows that the differences in moisture content of the tobaccos under normal conditions are small and it is very improbable that these differences will account for any one tobacco being infested to a greater degree than another.

The leaf used in the experiments was stripped off all the larger veins and torn into pieces, the pieces being well rubbed together and sifted to remove any adhering dirt or sand. It was then put into a dessicator, containing water in the experiment with the saturated atmosphere, and a solution of sulphuric acid giving the required relative humidity in the other experiments. About 7 days were allowed for the moisture in the tobacco and dessicator to come into equilibrium, after which the water was extracted under a reduced pressure of about 10 in. of mercury and at a temperature of about 75° C. The extraction was carried on until no loss of weight occurred in the sample under test. At each relative humidity two extractions were made on each type of tobacco, the leaf being taken from material obtained from different sources. The mean of the two readings was then computed. To some extent this obviated the difficulties arising from the differences in the physical properties of tobacco grown in different places.

The periodical use of a whirling psychrometer in the warehouses of Group "A" has shown that the relative humidity of the atmosphere in those buildings varies usually from 60 per cent. to 85 per cent.

TABLE XVII.—*Hygroscopicity of Tobaccos*

Type of Tobacco.	Relative Humidity.				
	20 per cent.	40 per cent.	60 per cent.	80 per cent.	100 per cent.
Bright kiln-cured Nyasaland	3·83 ¹	8·34	13·53	26·47	57·3
" " " Rhodesian	3·21	6·43	13·40	22·78	67·7
" " " Virginian	3·73	6·27	11·96	26·75	67·15
Dark kiln-cured Rhodesian	4·20	6·55	12·12	25·71	68·15
Fire-cured Rhodesian	2·73	6·33	11·49	21·54	63·70
" " Nyasaland	3·22	6·77	12·53	21·83	61·5
" " Virginian	2·79	7·28	12·64	—	69·25

¹ These percentages are calculated on the dry weight of the tobacco.

(6) Trapping Moths by Papers covered with Adhesive Substances

In a large London tobacco warehouse during the flight season of *E. elutella* in 1932 a large number of fly papers were hung for trapping moths. By this means it was hoped to reduce the infestation of the succeeding year by catching the females before they had deposited their eggs. To demonstrate their efficiency a number of the papers which had hung in two buildings during June and July were taken down and their catches analysed.

The insects were picked off the fly papers and washed in xylol. The sex of each captured *Ephestia* was determined and a rough measure made of the quantity of eggs laid by each female by observing the size of the remaining fat body and the number of eggs left in the ovaries. In some cases owing to the excessive drying out of the body this quantity could not be ascertained. Accordingly the females were divided into four groups:—

- (1) Those which had laid all or most of their eggs.
- (2) Those which had laid about half their eggs.
- (3) Those which had laid few or no eggs.
- (4) Those whose condition could not be determined.

The analysis of each fly paper is given in Table XVIII. The total number of *Ephestia* moths caught was 4,606, comprising 2,672 males, 1,907 females and 27 individuals whose sex could not be determined. Among the females were 98 (or 5.14 per cent. of the total number) which were replete with eggs and fat body, 435 (23.75 per cent.) which were assumed to have deposited about half their eggs and 1,327 (69.6 per cent.) in which only a few eggs and very little or no fat body could be observed.

The average numbers of moths captured by each fly paper were 39.23 ± 1.05 males and 27.99 ± 0.61 females and the respective standard deviations were 8.64 and 5.05.

(7) Experiments in Chemotropism

An experiment was devised with the object of testing a number of odoriferous substances with regard to their action upon the chemotropic responses of the moths. Some of these substances are contained in the essential oils of cacao and tobacco. Finnemore (1932); Gildemeister (1931); Halle, W. & Pribram, E. (1914). Unfortunately, through a delay in the delivery of the sticky material used on the traps, the traps were not hung until the main flight of moths had taken place in the cocoa warehouses in which the experiment was conducted. It is therefore considered unwise to draw any conclusions from the meagre results.

The traps were constructed out of cylinders of perforated zinc covered with "Tanglefoot" and suspended by wire. The substances serving as attractants were contained in tubes inside the cylinders, all except the tobacco extracts being made up as solutions in 70 per cent. alcohol. To prevent the growth of moulds a trace of boric acid was added to the water extracts of tobacco. The effects of light and draughts from windows and doors upon the traps were eliminated by shifting the traps round the warehouse daily in a systematic manner. Table XIX gives the substances used and the number of moths caught per day by each trap.

TABLE XVIII.—*Analysis of the Catches made on the Fly Papers*

Serial No.	Sex undetermined.	Males.	Total Females.	Females with			Total on Paper.	
				condition undetermined.	few eggs and small fat body.	moderate number eggs and moderate fat body.		many eggs and large fat body.
1	—	25	22	2	8	6	6	47
2	—	29	51	4	23	22	2	80
3	2	35	19	4	5	9	1	56
4	—	27	24	3	5	13	3	51
5	—	14	42	3	18	21	—	56
6	—	20	53	1	42	10	—	73
7	6	42	27	—	18	6	3	75
8	—	22	15	2	9	3	1	37
9	—	36	13	1	8	2	2	49
10	—	15	32	2	23	6	1	47
11	—	16	40	—	33	4	3	56
12	—	10	27	1	25	1	—	37
13	—	10	16	1	5	10	—	26
14	—	12	36	—	24	11	1	48
15	—	15	23	—	15	7	1	38
16	—	16	49	1	39	9	—	65
17	—	19	37	—	28	9	—	56
18	1	18	37	—	25	12	—	56
19	—	19	33	—	20	13	—	52
20	—	63	68	—	44	20	4	131
21	1	55	56	—	38	15	3	112
22	1	62	61	2	48	9	2	124
23	1	24	26	—	20	3	3	51
24	—	35	26	—	19	5	2	61
25	—	39	27	1	20	6	—	66
26	—	88	37	—	31	4	2	125
27	2	116	15	—	12	1	2	133
28	1	39	45	—	38	7	—	85
29	2	86	39	—	31	6	2	127
30	1	61	40	—	32	8	—	102
31	1	69	70	—	61	7	2	140
32	—	27	12	—	9	3	—	39
33	1	45	34	—	27	5	2	80
34	—	106	57	—	52	5	—	163

TABLE XVIII.—*Analysis of the Catches made on the Fly Papers—continued*

Serial No.	Sex undetermined.	Males.	Total Females.	Females with			Total on Paper.	
				condition undetermined.	few eggs and small fat body.	moderate number eggs and moderate fat body.		many eggs and large fat body.
35	1	98	57	—	50	5	2	156
36	1	113	20	—	16	2	2	134
37	—	116	42	—	37	5	—	158
38	—	23	13	—	8	4	1	36
39	—	27	11	—	7	2	2	38
40	—	20	22	—	16	4	2	42
41	—	11	14	—	12	1	1	25
42	—	23	13	—	10	3	—	36
43	—	58	20	—	8	8	4	78
44	1	41	17	—	11	5	1	59
45	1	42	17	—	13	2	2	60
46	—	59	15	—	9	4	2	74
47	—	44	18	—	12	5	1	62
48	—	35	23	—	13	6	4	58
49	—	33	16	—	13	2	1	49
50	—	34	23	—	11	9	3	57
51	—	39	15	—	8	6	1	54
52	1	38	18	—	11	6	1	57
53	—	28	17	—	10	5	2	45
54	—	36	13	—	6	5	2	49
55	—	32	14	—	10	4	—	46
56	—	19	8	1	5	1	1	27
57	—	33	14	—	6	6	2	47
58	—	47	16	—	11	5	—	63
59	—	13	17	—	10	5	2	30
60	—	33	32	—	25	7	—	65
61	—	43	12	—	9	2	1	55
62	—	28	33	—	22	9	2	61
63	—	24	22	—	14	7	1	46
64	1	35	42	—	30	9	3	78
65	—	29	11	—	8	2	1	40
66	1	34	31	—	18	12	1	66
67	—	27	18	—	11	7	—	45
68	—	42	24	—	12	10	2	66
Total	27	2,672	1,907	29	1,327	453	98	4,606

TABLE XIX.—*The substances used in the chemotropic experiment and the number of moths caught on each trap*

Trap.	Substance used on Trap.	Moths caught per day.
W	Water extract of Rhodesian flue-cured tobacco	2.25
X	Water extract of Nyasaland flue-cured tobacco	1.75
O	0.15 per cent. alcoholic solution of Amyl valerianate	1.00
G	0.15 per cent. alcoholic solution of N-butyl acetate	1.00
Z	No solution. Control	0.95
V	Water extract of Virginian flue-cured tobacco	0.91
F	0.15 per cent. alcoholic solution of Ethyl Propionate	0.83
N	0.15 per cent. alcoholic solution of Linalool	0.75
U	Alcoholic extract of Nyasaland flue-cured tobacco	0.66
R	2 per cent. alcoholic solution of a proprietary cocoa essence..	0.625
H	0.15 per cent. alcoholic solution of Bornyl acetate	0.625
S	Alcoholic extract of Virginian flue-cured tobacco	0.62
M	0.15 per cent. alcoholic solution of Coriander oil	0.56
K	0.15 per cent. alcoholic solution of Iso-valeric acid	0.54
T	Alcoholic extract of Rhodesian flue-cured tobacco	0.50
Y	70 per cent. alcohol. Control	0.50
A	0.15 per cent. alcoholic solution of Geranyl acetate	0.46
D	0.10 per cent. alcoholic solution of Ethyl isovalerate	0.41
J	0.15 per cent. alcoholic solution of Isobutyl acetate	0.41
C	0.15 per cent. alcoholic solution of Linalyl acetate	0.375
L	0.15 per cent. alcoholic solution of N-propyl acetate	0.33
E	0.15 per cent. alcoholic solution of Propyl acetate	0.33
B	0.15 per cent. alcoholic solution of Ethyl butyrate	0.31

E.—THE CONTROL OF EPHESTIA ELUTELLA

(1) Introduction

The problem of the control of insects in imported stored products naturally divides itself into two parts, viz. :—

- (a) Control in the exporting country.
- (b) Control in the importing country.

Obviously the control measures will be most advantageous if carried out before the commodity leaves its country of origin. No matter how strictly these measures may be put into practice at home, the

constant importation of infested materials necessitates a continuous vigilance on the part of the merchants and warehouse staff and a continual expense in fighting the new infestations. Very often by the time the leaf has reached England the infestations are moderately severe, but in cases where tobacco has travelled without undue delay from its country of origin one has more difficulty in detecting the presence of the insect.

The present widespread distribution of *Ephestia*, not only in tobacco, but also in cacao and dried fruit, makes it imperative that a close co-operation between entomologists, merchants and manufacturers should be maintained in order to carry out a successful control programme. For various reasons, among which perhaps the most important is the somewhat cynical indifference with which the pest is looked upon in some places, especially on the Continent, this co-operation is not yet attained. The many difficulties should be boldly faced and every endeavour made to surmount them. Effective control in one or two of the badly infested regions abroad would greatly relieve the situation as a whole.

(2) Sources of Infestation and Re-infestation during Transport

It is evident that there may be several sources of infestation of tobacco both during storage and during transport. There are the warehouses abroad in which the tobacco is placed after being cured and packed: infestation may occur in these warehouses either because they are themselves infested or because some tobacco sent into them is infested. These warehouses may be inland or on the seaboard. Infestation may also occur on shipboard, for unless the ships which bring the tobacco to England are kept scrupulously clean insects arising from previous cargoes may cause trouble. There is also the risk of infestations of tobacco by insects from commodities shipped at a subsequent port of call. The many pupal exuviae of *Ephestia* found in bales immediately on receipt in London are evidence of recent infestations, the moths having escaped. It is possible that some of those moths were left on the ship that carried the tobacco.

Usually nothing else besides tobacco is stored in the tobacco warehouses in England, but other products may be housed in neighbouring buildings. Therefore clean tobacco entering these warehouses will be affected only by insects already in the warehouse or, if it

remains in bond for some time, by insects which may be brought in afterwards in tobacco from another country. It is possible that *Ephestia* may spread into tobacco warehouses from infested products stored nearby.

In the tobacco factory, if infested tobacco is immediately re-conditioned (see Section D1) all stages of *Ephestia* are killed. Subsequent infestation may, however, arise during the manufacture of the tobacco, either by insects escaping from tobacco before reconditioning, or from a standing population in the factory.

(3) The Responsibility of the Warehousekeeper and others concerned

As shown in section E2 raw tobacco is open to infestation at all stages during its transport from packing shed to factory. It therefore behoves every person handling the leaf to endeavour to protect it from *Ephestia* while it is under his care. The despatch of an infested consignment of tobacco from abroad to a merchant at home, or from a warehousekeeper to a merchant or manufacturer, may be the cause of the merchant placing his orders elsewhere or of the manufacturer storing his leaf in buildings which he considers to be managed in a more efficient manner. In this way trade suffers and loss of prestige occurs, a loss which may never be regained.

An excellent attempt to "put one's house in order" has recently been made by the Government of Southern Rhodesia by the passing of The Tobacco Pests Suppression Act, 1931. By this act the export of unmanufactured tobacco is prohibited except from licensed warehouses. A warehouse is liable to inspection at any time, and, if found to be infested by *Ephestia* or *Lasioderma*, the owner's licence may be suspended. The maximum penalty for infringement of this law is £200. If this act is strictly and conscientiously enforced the export of infested tobacco from Southern Rhodesia will be arrested. However, Southern Rhodesia has no seaport within its own territory. Consequently, a partial or complete invalidation of the benefits expected from this legislation may occur unless the tobacco is protected during its transport to Beira through Portuguese East Africa and whilst it is in store in that port. Similar legislation put into execution in other tobacco producing countries would be a wise

procedure.¹ The activities of *Ephestia* would be considerably restricted and the anxiety of the trade from a threatened loss of business or prestige greatly alleviated.

A strict inspection ought to be maintained over all tobacco entering bonded warehouses or factories, so that infestations may immediately be brought to light. Examinations can best be made whilst the tobacco is being sampled but, unless sufficient time be given to those inspections, small infestations may be overlooked. All workmen and others engaged in the tobacco trade should be familiar with the appearance and life histories of *Ephestia* and *Lasioderma*. For the dissemination of this knowledge a special article has been prepared (Bovingdon, 1931), which will help to prevent a repetition of the confusion which has hitherto been made between those two pests.

It is in the interests of merchants and manufacturers to store their supplies in the most hygienic and efficiently supervised warehouses available. All bright types of leaf are very liable to infestation and if stored for a short period, especially during the summer months, in an infested warehouse a consignment may be badly damaged and its monetary value reduced. There is also the risk that trouble may follow when the tobacco is brought into the factory for manufacture.

E. elutella must always be considered as a potential danger to manufactured tobacco. In small factories where the leaf is not reconditioned by steam as described in Section D1 and E5, the finished tobacco and cigarettes may subsequently be found to be contaminated. Even in large factories where efficient reconditioning machines are installed that risk is not entirely eliminated. The adult moth flies with ease and may readily find its way from unconditioned tobacco into rooms where the actual manufacture is proceeding. For this reason the use of reconditioning machines and their installation in a room well separated from the rest of the factory are strongly advocated. The discovery by a client of insects or frass in a packet of cigarettes may be a serious matter and one which manufacturers cannot afford to treat lightly, for it involves loss of prestige and a curtailment of business.

¹ Under section 28 (b) of Agricultural Pests Act, 1911, as amended by the Agricultural Pest Act, Further Amendment Act, 1924, " All unmanufactured leaf tobacco introduced into the Union of South Africa must, unless specially exempted, be accompanied by a certificate issued by the Department of Agriculture of the country of origin, stating that after examination and to the best knowledge of the examining officer, the tobacco in question is free from infestation of *Ephestia elutella*."

(4) Palliative control measures against *Ephestia* in Warehouses, Factories, etc.

General measures

For the prevention of an outbreak of *Ephestia*, or in dealing with an existing infestation, one's first attention should be given to the preservation of general cleanliness in the buildings.

Wherever practicable, warehouses should be periodically cleared of all tobacco and the whole of the walls, ceilings and pillars, after being thoroughly swept down, treated with hot limewash. If the removal of the tobacco is not possible the bales, etc., should be covered by tarpaulin whilst limewashing is in progress. Mossop (1932) recommends the use of a limewash made from quicklime with about twice its volume of water and the addition of common salt at the rate of about 1 lb. to every 10 gallons of wash. He also advises the employment of a high-pressure, spraying machine for the application of the liquid so that cracks and holes may be filled.

No rubbish should be allowed to accumulate over the floors, in corners, on windowsills, etc., and all scrap tobacco must be collected and immediately burnt. All loose boards, etc., beneath which caterpillars can crawl and hide should be removed and all cracks in walls and floorboards stopped up. Similar measures must be carried out in factories, sample rooms or other places where tobacco is stored.

The arrangement of bales and casks in warehouses must be orderly, spaces being left at intervals between the piles, and between the piles and the walls. This orderliness combined with cleanliness facilitates the discovery of moths and wandering larvae which indicate an incipient infestation or the continuation of an already existing one. As a further aid all windows should be periodically cleaned so as to admit as much light as possible into the building. Windows are generally badly neglected and *Ephestia*, especially before and during the time of oviposition, seeks obscurely lighted situations. Apart from the habits of *Ephestia*, good lighting in warehouses makes inspection easier and more efficient.

Kirschner (1931), writing on the control of a severe infestation by *E. elutella* of the store rooms of a food product factory in which fumigation was impossible, advised the removal of the stores, the spraying of the rooms with nicotine soap solution and the smearing over of all cracks with a paste of water-glass and plaster of Paris.

These general palliative and precautionary measures are more difficult to carry out in an old wooden warehouse than in a modern one of reinforced concrete. Consequently old buildings generally require closer attention. In the modern buildings ideal conditions can be maintained if the little necessary trouble is taken.

Fumigation

The main problem of fumigating tobacco is considered in Section E5a. The fumigation of warehouses is a matter which often arises in connection with the storage of other commodities besides tobacco and the usual fumigants employed are hydrocyanic acid gas and ethylene oxide. The principal difficulty in the work is to maintain the desired concentration of gas for the requisite period of time. Great care should be taken to prevent leakages through holes and cracks in floors, walls, roofs, windows and doors, and due allowance be made for the absorption of the toxic substances by the floors and walls, etc., of the buildings, and by the commodities stored within. All rubbish should be removed before fumigation. In view of the habits of the full-grown larvae of *Ephestia*, it is important that every facility should be given for the gas to penetrate behind wainscoting, mouldings, etc., where the insects are hiding.

The fumigation of empty warehouses may be done with hydrocyanic acid (HCN) at the rate of not less than about 10 oz. (284 grms.) per 1,000 cub. ft. and the buildings should be closed for at least 24 hours. If ethylene oxide is used a dose of about 60–80 oz. per 1,000 cub. ft. should be given for a period of 48 hours.

Trapping of Moths and Larvae

In the experiments with sticky fly papers, Section D6, the real efficiency of the traps is represented by the number of captured egg-replete females—a very low figure of 5.14 per cent. One might have expected this when it is remembered that the female insect "calls" for copulation almost as soon as it has emerged from the pupa and, after copulation, usually seeks obscurely-lighted places for the act of oviposition. The traps could be made more efficient if the sticky preparation was impregnated with a substance attractive to the moths. The experiment made to discover such an attractant, Section D7, unfortunately gave very poor results. Nevertheless, the use of good fly papers can be recommended in conjunction with other control measures, but it must not be relied upon alone.

Whether the destruction of so many male moths reduces the chances of surviving females of being fertilized, thus resulting in a diminution of oviposition, is not known. The question remains open until we procure reliable data relating to such problems as the normal ratio of the number of female moths to males in the warehouses and the frequency of copulation by males.

Zacher (1928) says, in connection with the use of light traps, that the captured moths were chiefly males or females that had oviposited.

Noyes (1930) made experiments in the trapping of moths in cacao warehouses. From a number of baits that were tested she found the best to be vinegar mixed with fermenting fruit sugar in the ratio of 1 : 3. The individual substances in the mixture which were ultimately responsible for the marked chemotropism shown by the moths were unidentified.

Knapp (1921) reports that cold tea, prepared as for drinking with milk and sugar, exerts an extraordinary attractive bait for moths when placed in shallow tins in various parts of cacao warehouses. Cocoa prepared in a similar way is not so attractive as tea.

Mossop (1932) made some tests with papers and pans smeared with chocolate upon which moths could oviposit but no eggs were procured. He also experimented with pans containing water and chocolate water for catching moths, but met with unpromising results.

Zacher (1928) working in cacao warehouses secured his best catches of *E. elutella* with a solution of amyl acetate in water in the ratio of 588 : 100. Low concentrations of oil of cassia or of nitrobenzol were little better than pure water, and if used at a greater concentration they definitely repelled the insects.

Wandering larvae can be caught by long strips of paper covered with a good adhesive and fastened to the walls of an infested room, or laid upon the floor round an infested pile of bales. Strips of corrugated cardboard or paper tacked to the walls with the corrugations vertical form efficient traps. Their action depends upon the habit of the fully fed larvae seeking small crannies for hibernation and for pupation. These strips should be taken down and renewed at various periods after the main flight of the moth. The old ones should be burnt.

(5) Control Measures against *Ephestia* in Packed and Manufactured Tobacco

Fumigation

A fumigant for treating tobacco should possess the following properties :—

It should be :—

- (1) Highly toxic to insects.
- (2) Non-toxic to man and domestic animals.
- (3) Non-injurious to the aroma and smoking qualities of tobacco.
- (4) Cheap.
- (5) Convenient to use.
- (6) Diffuse rapidly at ordinary temperatures.
- (7) Easy to transport, safe to handle, non-inflammable, etc.

If a mixture of gases is used, the components of the mixture should diffuse with equal speed so that the gases do not separate. Ethylene oxide and carbon dioxide (CO₂) is such a mixture, for equal volumes of these gases at the same pressure are of equal weight.

The dense mass of tobacco in a bale or cask packed under hydraulic pressure considerably impedes the free diffusion of gas into its interior. To a depth of about 6 in. however the packing is somewhat looser due to the arrangement of the "hands", the "butts" of which mostly lie at the surface. Thus, just where *Ephestia* is most usually found in the bales, the lethal gas has little difficulty in penetrating if the diffusion is good. If complete penetration is desired one may either use repeated doses of high concentration or, although the method is expensive and not generally applicable, resort to vacuum fumigation.

The chief objection to HCN as a fumigant is its high toxicity to man. For this reason great care should be exercised in its application and all precautions should be taken to prevent possible accidents. Where the fumigation is in the hands of a reputable fumigation company the chances of accident are negligible. The action of HCN on tobacco has been tested and, according to published and unpublished results of several fumigations of tobacco, the aroma of the leaf is in no way affected. Buttenburg and Weiss (1924); Runner (1919).

The fumigation may be carried out in a warehouse, a steel barge or lighter or in a special chamber. The great difficulty is to reduce the leakage and absorption of the toxic agent to a minimum in order

to maintain the concentration at its effective strength. A specially constructed gas-tight, steel room makes an ideal fumigation chamber in which leakage is absent or, at least, negligible and in which no trouble is encountered through absorption by the material of the chamber itself. A well-made, steel barge is a good substitute where a special chamber is not available but the large open hold must be effectively covered in by well-fitting, wooden covers and the interior kept dry and free from bilge-water. An ordinary barge may often be made sufficiently air-tight by placing over the hatch covers two or three thicknesses of good, stout tarpaulin and by battening down the edges by means of boards and weights.

The large modern warehouses of reinforced concrete do not present much difficulty in rendering air-tight, but to carry out a successful fumigation in one of the older buildings requires a good deal of preparatory work in sealing cracks and mending holes. Another difficulty in fumigation work is to obtain an equalized distribution of gas throughout the space to be fumigated. In a special chamber this difficulty may be overcome by the installation of a fan to circulate the air. In treating a large warehouse advantage might be taken of convection currents caused by the artificial heating of the air in various places over the floor of the building. A new apparatus for vaporising liquid HCN has just been devised. This will ensure the vaporisation of the whole of a quantity of liquid placed into it and, at the same time, form convection currents which will aid the distribution of the gas. A number of generators working at different points should give a fairly even concentration of gas throughout the building.

Where the fumigant can be applied as a spray by forcing it through an atomizer a fairly even distribution should be obtained. One disadvantage of this method is the liability of the loss of effective fumigant through condensation arising from the sudden expansion of the gas, and by its solution in water which may be condensed from a humid atmosphere near the orifices of the jets. The temperature of the air in a fumigated space is another factor to be taken into account during fumigation. Much better results are obtained during warm weather than during cold weather. The practice of heating stored products at the time of fumigation for the purpose of increasing the toxicity of the fumigant by stimulating the respiratory mechanism of the insects appears to be of little use. Cotton (1932) has studied the effects of ethylene oxide on the adults of *Tribolium confusum*

Duv. In tests at 80° F. insects kept at 50° F. for several days prior to the fumigation required a dose of 40 mg. per litre to effect 100 per cent. kill in 3 hours, whilst others kept at 80° F. for the same time required only 22 mg.

To obtain the best results from the application of heat during fumigation sufficient time should be allowed for the insects to adjust their metabolism to the higher temperature. The practical application of Cotton's observation may be made in the fumigation of produce which has just been removed from cold storage. The produce should be allowed to heat up until the temperature reaches that at which the fumigation is to be done. In the ordinary fumigation of tobacco the increased kill gained by the application of heat to large masses of tobacco for one or two days before fumigation would perhaps not compensate the cost involved. It might be cheaper to raise the concentration of the fumigant to offset the lower temperature.

In the vacuum fumigation experiments described in Section D2 one of the arguments given for heating the chamber during the fumigation was that the respiration of the insects was increased and the time required for the treatment consequently reduced.

A knowledge of the efficiency of a fumigation may be obtained by making determinations of the concentration of the gas in various parts of the warehouse or lighter. The concentration inside bales and casks of tobacco should also be determined to ascertain if the gas has reached all places where insects are likely to be found. Apparatus for these tests has recently been improved in this laboratory by Page (1932).

In warehouse and barge fumigation the high initial concentration attained immediately after the release of the gas is never maintained. It rapidly falls off to a degree dependent upon the extent of the leakage and upon the rapidity with which the gas is absorbed by the fumigated products, by the materials used in the construction of the building or by water vapour. This loss must be allowed for in calculating the quantity of fumigant to be used.

If HCN is used for the fumigation of tobacco a fairly high dose should be given in order to ensure effective treatment. From 15 to 20 oz. (425 to 569 grms.) per 1,000 cub. ft. should be used and the fumigation should last for at least 48 hours. For fumigating bulked or baled tobacco Mossop (1932) recommends a dosage of about ten

times the usual amount used in household fumigation. With the pot method of generating the gas 100 oz. of sodium cyanide with the requisite amount of sulphuric acid are necessary for each 1,000 cub. ft. of space or, if the "Zyklon" method is employed, a one "1200 gram." tin of Citrus Zyklon. He recommends a fumigation period of 48 hours and the use of a special chamber.

In recent years ethylene oxide has been recognized as an excellent fumigant for stored products and its use in this sphere is rapidly growing. Compared with HCN it is very much less dangerous to man but at the same time it is very toxic to insects, especially to their eggs. At normal temperatures it is a colourless inflammable gas but at the concentrations employed in fumigation work it can be used with safety. It hydrolyses with water to form glycols or similar compounds which are probably non-toxic. Roark and Cotton (1929) recommend its use at the rate of 2 lb. per 1,000 cub. ft. (33 grms. per cub. metre) for 24 hours. There is no evidence that ethylene oxide is injurious to the aroma of tobacco.

"Etox" or "T" gas, a mixture of ethylene oxide with about 10 per cent. of carbon dioxide, was first used in Germany in 1930 and found successful in the fumigation of stored products. The carbon dioxide by virtue of its lower boiling point helps to force the ethylene oxide out of the cylinders in which the fumigant is carried. It is also thought that the added carbon dioxide causes insects to open their spiracles and increase their rate of respiration. Hazelhoff (1928) noticed this action of carbon dioxide on cockroaches. Cotton (1932) gives an account of experiments showing how CO_2 when added to some fumigants increases their toxic action. The rôle of mixtures of fumigants and carbon dioxide needs further investigation.

An American fumigant called "Carboxide" is a mixture of ethylene oxide with 80 per cent. to 90 per cent. of dissolved carbon dioxide and is stored in gas cylinders. Its action depends upon its content of ethylene oxide, the CO_2 being added to render the mixture non-inflammable. During ethylene oxide fumigations estimations of the concentration of gas should be made as mentioned above in fumigation with HCN. A method of estimating ethylene oxide has been described by Lubatti (1932) of this laboratory.

Vacuum fumigation with ethylene oxide, from the point of view of efficiency, is a most successful method of suppressing insect infestations in stored products. The capital outlay on the plant is high

owing to the special mechanical construction of the fumigation chamber and the various accessories attached to it, but the advantages of the method are considerable. There is an absence of leaks, no absorption of the gas by the steel walls of the apparatus and the penetration of the gas into dense masses of material is ensured. Although it may be economical to use vacuum fumigation for the sterilization of manufactured tobacco, the cost of the treatment is probably prohibitive where unmanufactured tobacco leaf is to be fumigated. An account of three experiments in vacuum fumigation is given in Section D2. The results of the tests demonstrate the efficiency of the method when a lethal dose of gas is given and when sufficient time is allowed for the fumigation. The short period which was given in the second experiment is most probably the factor responsible for the incomplete kill of the eggs of *E. kühniella*, although the concentration of the gas was greater than in either of the other experiments. The residual gas left behind in the leaf was too small to be determined by the method adopted, i.e. a slight modification of that of Südendorf and Kroger.

It is a common belief that insect's eggs are burst under a vacuum of 27 in. to 29 in. of mercury (Morgan, 1932). A few preliminary experiments conducted by the writer have shown that in a vacuum of 29 in. of mercury the eggs of *E. kühniella* are unharmed after one hour's treatment. Out of 99 two-day-old eggs subjected to 29 in. for one hour, 99 hatched. In another experiment 84 eggs were exposed to the same vacuum for half an hour and 81 hatched. Back and Cotton (1925) subjected eggs of the clothes moth, *Tineola bisselliella* Hum., to a vacuum of 26 in. to 29 in. for two days. Only 40 per cent. of the eggs were killed.

Low Temperatures

A very practical method of destroying insects in stored tobacco is by the use of reduced temperatures. A knowledge of the low temperature resistance of *Ephestia* and of the rate of conduction of heat through tobacco has now been acquired, an account of the experiments being given in Sections D3 and 4. The cold resistance of *E. elutella* has been found to be much less than that of *E. kühniella*. Therefore by basing low temperature treatment of infested tobacco upon the times and temperatures required to give 100 per cent. mortality for *E. kühniella* one can be quite sure that all stages of the other moth are destroyed.

The period for which a consignment of tobacco must be kept in cold store to reduce its temperature throughout to the temperature of the store is more difficult to recommend. It depends upon the size of the cold chamber, its initial temperature, the original temperature of the tobacco, the quantity being treated and the efficiency of the cooling system. Consequently the results of the experiments in Section D4 should be regarded as applying only to the conditions under which those experiments were conducted. They give an idea as to the rate of flow of heat through bales and casks of tobacco and form only a guide in calculating the time of storage at a reduced temperature where conditions are different from those in the above-mentioned tests.

The charges made by cold storage firms are frequently quoted for a period of storage of 7 days or for multiples of 7 days. The greater part of the cost of storage is absorbed by labour charges for filling and emptying the rooms and it costs almost as much to store tobacco for a fortnight as for a month. In dealing with temperatures below -6°C . a month is generally ample time for the storage of bales but a longer period may be required for hogsheads. It is advisable always to insert a thermocouple or other temperature measuring apparatus into one of the packages situated near the centre of the room, so as to make sure that the desired temperature is attained. A 5 per cent. or 10 per cent. margin of safety should be allowed.

With tobacco imported from a distant country where a long sea journey is involved the question of the deinfestation of tobacco by low temperature storage in the ship's hold should be considered.

The air in the rooms should be as dry as possible and "defrosting" should be done, as far as possible, on dry days or in a "defroster" in which the temperature of the circulated air is raised gradually. These precautions will reduce the liability of the tobacco to "sweat." With regard to the effects of low temperatures on the quality of the tobacco, Runner (1919) writes, "When care is taken to prevent 'sweating' it is evident that the exposure of manufactured or leaf tobacco to cold storage is not more apt to produce injury than would the exposure of the same material to low temperatures during the winter." In a series of experiments he made on tobacco, cigarettes and cigars exposed to low temperatures for 30 to 50 days, the treated tobacco was compared with untreated tobacco by an expert who could not distinguish between the two.

A very vexing problem which has recently arisen during the preliminary work in the low temperature storage of tobacco is the tainting of the rooms. It is well known that many food products, especially those containing fat, will absorb the volatile products from cured tobacco. Besides this it appears that much of the lagging used in the walls of the cold rooms also has this property and having once contained tobacco these rooms will smell of tobacco for months. It is known that some rooms have been more or less permanently rendered useless for the storage of other commodities. If there is no constant demand for the cold storage of tobacco considerable loss may be incurred by the owners of the cold stores. Various remedies have been tried in attempts to deodorate the rooms but no success has yet been obtained. The problem could doubtless be solved by the prosecution of organised research work.

Reconditioning of Tobacco

The importance of reconditioning tobacco by live steam has been emphasized in Section D1. The protection of a factory from *Ephestia* infestation depends almost wholly upon the reconditioning operations being done in rooms or buildings well apart from the rest of the factory. The reconditioned leaf should then be protected from infestation while on its way to the rooms where the next operations in manufacture are proceeding. This isolated reconditioning operation makes it difficult for moths and larvae, which happen to come in with the bales from the warehouse, to reach the tobacco whilst it is in process of manufacture.

Supplementary measures

Mokrzecki (1931) suggests control measures for use against *Ephestia* in Poland. He stated that larvae can be made to leave the bales by raising the temperature of the warehouse to 50° C. and watering the floor. The larvae, responding to a hydrotropism, congregate around the small pools of water which form on the floorboards. Obviously English tobacco warehouse practice would not allow the adoption of the measure although it is a popular procedure in Turkey. He also recommends the packing of high grade qualities of leaf inside at least three layers of lower grade. Where a small quantity of very valuable leaf required protection this measure may be of practical use, but in dealing with large quantities of ordinary cigarette leaf the time and money spent in putting the measure into practice would not justify the saving effected. Experiments in the disinfection of tobacco by

hot air in a special chamber are described by Mokrzecki. At temperatures varying from 45° C. to 64° C. all larvae were killed in 5 to 30 minutes provided that the tobacco was loosened to allow the hot air to penetrate. In unopened bales subjected to a temperature of 70° C. the larvae remained alive as the temperature inside the bale did not exceed 37° C.

(6) The use of Crates for Protecting Bales

In Section B2 the question of the wrapping of bales is considered and it was found that none of the methods in present use was effective in preventing the infestation of tobacco. A bale wrapped in good thick brown paper, sealed at the overlapping edges and covered with one or two hessian wrappers would be quite safe if the wrappers remained intact. This end could probably be achieved by packing the bales into close fitting crates which would prevent damage to the paper wrapping and do away with the necessity of the use of hooks for shifting the bales. It would be advantageous if experiments could be undertaken to prove the efficacy of crating tobacco bales.

The relations between the conditions of the curing and packing sheds in the exporting country and the conditions of the tobacco on arrival in England could also be tested by means of experimental consignments. From the results of such experiments control measures might be devised. Proposals for co-operative work on these lines have been agreed to by the Southern Rhodesian Department of Agriculture, and funds are now available for this work.

(7) Biological Control

In recent years much attention has been focussed on the biological control of pests by their natural parasites. Mention has been made in Section B8 of *Microbracon hebetor* Say, a small hymenopterous parasite of *Ephestia* larvae. Up to the time of writing this report this insect has not been found in any tobacco warehouse examined by the writer, but there is the possibility of its introduction at some future time from a tobacco-exporting country such as Southern Rhodesia in which it commonly occurs.

The absence of this parasite in the tobacco warehouses is somewhat surprising especially when one considers that it occurs very commonly in cacao and dried fruit warehouses a few miles away. It is not probable that temperature and humidity factors are responsible for

this irregularity in distribution because the records of these factors obtained in the cacao warehouses by members of the staff of this laboratory do not disagree very widely from those periodically obtained in the tobacco stores. The density of the *Ephestia* population in the cacao warehouses is usually much higher than that in the tobacco bonds. This might act favourably upon the rate of propagation of the parasite in the cacao warehouses.

It would be unwise to make any other statements as to the probable cause of the absence of *Microbracon* in English tobacco warehouses because the whole problem of its life history and of the interrelation of the insect, physically and biologically, with warehouse conditions needs much careful study. One may then be in a position to consider the possibility of introducing *Microbracon hebetor* as an auxiliary method of control of *Ephestia* in tobacco.

(8) Periodicity of the Infestations

Many species of insects under natural conditions vary in numbers from year to year in a given locality. Sometimes these fluctuations in density of population over a number of years is so marked that they give rise to the phenomenon of periodicity. An infestation may from no apparent reason die down to almost insignificant proportions and, for one or two years, may give no trouble at all. Then as the result of a combination of physical and biological factors, which are still little understood, the pest suddenly breaks out again with renewed violence necessitating prompt and extensive palliative control measures.

This periodic phenomenon is well seen in certain insects living in the open and exposed to the many changes in the physical, chemical and biological environments which vary with the weather. Among stored products insects which are usually protected from these changes, periodicity is not such a well-marked phenomenon. The conditions in a warehouse are more or less artificial owing to the mitigation of the severity of outside temperatures, humidity, insolation, etc. Very little of the work so far done on stored products insects has thrown any light upon periodicity if it occurs among these insects.

The prosecution of work on the many problems underlying this phenomenon is considered very important and Professor J. W. Munro is now directing research in the laboratory on such questions as the factors affecting the fertility of *Ephestia kühniella* and the respiration of stored products insects under varied conditions.

Investigations on *E. elutella* have not yet been carried on long enough for one to be able to say that the fluctuations in its numbers from year to year constitutes periodicity. Nothing was known about the occurrence of the moth in the London tobacco warehouses when the serious outbreak of 1929 occurred. Since then the number of moths in warehouse group "A" has certainly diminished but the area of infestation has extended and the insect has distributed itself more evenly among the various buildings. The large exports of infested tobacco which followed the outbreak of 1929, together with the effect of the various palliative measures adopted for relieving the grave situation, accounted for the few moths seen in 1930. The main cause of the extended distribution of the insect seems to be in the constant importation of infested leaf from various foreign sources. The whole question requires and deserves careful attention.

(F).—MISCELLANEOUS MATTERS

(1) Pecuniary Losses to the Tobacco Trade

The infestation of tobacco by *Ephestia* has resulted in a considerable loss of money to the producers, merchants, brokers and manufacturers engaged in the tobacco trade. These losses have been incurred in several ways, namely :—

Depreciation in value of tobacco due to actual damage by *Ephestia*.

Depreciation in value of tobacco due to some part of a consignment being infested.

The necessity of having to sell stocks at short notice.

Charges for cleaning infested bales and casks, i.e. brushing, fumigation, low temperature storage.

Cost of other control measures.

Loss of prestige and business following the sale of infested cigarettes.

The actual quantity of tobacco consumed by the larvae is usually negligible, but in many cases a considerable amount of leaf is destroyed.

During the heavy selling of infested tobacco in 1929 and 1930 the value of the leaf was often reduced by 40 per cent. or 50 per cent. The actual losses might have been heavier had the outbreak occurred on a normal market, but at that time the price of Rhodesian tobacco was abnormally low owing to over-production. On the continent the

knowledge that the tobacco was infested resulted in the leaf exported from this country being sold at prices 30–50 per cent. below those which clean leaf demanded, but these low prices may have been partly due to the Continental merchants having a knowledge of the excessive stocks in the British warehouses.

Many British manufacturers, knowing that Rhodesian and other tobaccos were affected by *Ephestia*, would not buy at any price, owing to the risk of contamination in their factories. The attitude certainly caused some diminution in the trade in African tobacco, but the losses on this account are difficult to estimate.

As a result of the infestation the direct and indirect losses sustained by the Tobacco Trade in twelve months since August 1929, was in round figures at least £100,000.

(2) Difficulties experienced in the Work at the Docks

At present we are greatly handicapped by difficulties which restrict our investigations outside the laboratory and our work would be greatly facilitated if these obstacles were removed.

The devising of control measures against insect pests depends upon our knowledge of the life of insects under natural conditions and upon our acquaintance with the environment in which they live. Their ecology must be thoroughly studied. Sufficient knowledge and experience can be obtained only by intensive study of these problems in the docks and warehouses. During that work the officials in charge and all those they supervise have helped in every way so far as their authority would permit.

It would be to the best interests of all concerned if we could extend our inquiries and regularly search the warehouses for insects and their parasites, and also have facilities for making a few simple experiments. These experiments would involve no disarrangement of warehouse routine, but most of them would require to be extended over a prolonged period in order to ascertain the behaviour of the insect under the constantly changing conditions of environment and warehouse activity.

(3) Difficulties encountered in the Laboratory

The difficulty of the mass rearing of *Ephestia elutella* throughout the year and the consequent restriction in the experimental work upon that insect has already been mentioned in Section C1. Apart

from this the most serious trouble has been caused by predaceous mites feeding on insects' eggs and by a bacterial disease (Section B8), both of which have often rendered the mass breeding of insects very difficult to my colleagues and other workers. Among the mites the following have been identified:—*Cheyletus eruditus* Schrank, *Haemogamosus oudemansi* Hirst and *Typhlodroma* sp.: Occasionally *Cheyletomorpha venustissima* C. L. Koch has been found, and *Tyroglyphus longior* Gervais is a common non-predaceous species which can almost always be found among cultures of *Ephestia*.

G.—SUMMARY

The letters and numbers refer to the sections of this report.

The reasons for the outbreak of *Ephestia* in London in 1929, are obscure. Most probably it was due to an infestation of insects in tobacco from abroad. A1, A3 and B4.

Ephestia feeds principally upon bright cigarette leaf and the enormous stock of this tobacco stored in London in 1928 and 1929 was doubtlessly a factor contributing, in no small way, to the grave infestation of 1929. A4.

The moths and larvae in the city sampling rooms arose from samples drawn from infested bales. B2.

So long as bales are damaged during their transport to the United Kingdom no form of hessian or paper-hessian covering at present used will be effective in preventing their infestation by *Ephestia*, B3 and E6.

Ephestia is continually being imported in tobacco from East and South Africa, Greece and at times from Russia and America. It is also known to attack tobacco in Poland and Bulgaria. B4.

Ephestia has been found feeding upon kiln-cured and air-cured tobacco from S. Rhodesia, Nyasaland, Cape Province, Macedonia, Russia and America. B5.

The insects, other than *E. elutella*, found in tobacco and bonded tobacco warehouses are enumerated. B6.

The differences between the ravages of *Ephestia* and *Lasioderma* are described. B7.

There is still much to be done to complete the study of the life history and the habits of *E. elutella* in the tobacco warehouses. B8.

In spite of careful observation in the warehouses, etc., no parasites or diseases have been found attacking *Ephestia*. B9.

The life cycle of *E. elutella* under controlled conditions has been studied. C1.

Ephestia does not feed upon fire-cured tobaccos. C2.

The adult moth shows a decided preference for bright kiln-cured tobaccos when seeking a place for oviposition. C3.

The larvae cannot subsist on hessian. C4.

Ephestia cautella, *E. kühniella* and *Plodia interpunctella* will not live on cured tobacco. C5.

The reconditioning of tobacco by a modern machine will destroy all stages of *Ephestia*. D1 and E5c.

Vacuum fumigation with ethylene oxide is a successful method of treating infested tobacco, but the cost may be prohibitive. D2 and E5a.

Ephestia can be controlled by low temperatures. D3, D4 and E5b.

There is no apparent correlation between the hygroscopicity of a tobacco and its liability to infestation by *Ephestia*. D5.

Too much dependence should not be placed upon the control of *Ephestia* by fly papers. Other measures for trapping larvae and moths are given. D6, D7 and E4c.

The control of *E. elutella* in tobacco is discussed. E.

The losses suffered by the trade in 12 months from August 1929, was about £100,000. F1.

The difficulties encountered in the intelligence work at the docks and in the laboratory work during the investigation are mentioned. F2 and F3.

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K.—APPENDIX

Effect of low temperatures on Lasioderma serricorne Fab.

As *Lasioderma serricorne* is very often found in company with *Ephestia* in tobacco it would be advantageous if, during the low temperature control for the eradication of *Ephestia*, both insects could be killed simultaneously.

No opportunity has been found by the writer for carrying out many experiments in the cold resistance of *Lasioderma* but several references have been found in the literature relating to this problem. The only experiments which can be compared with the results of the experiments in Section D3 are some made by Runner (1919).

Experimenting on exposed eggs at -7.8 to -10° C. (14° to 18° F.) he found that all were killed in periods of over 24 hours. At a constant temperature of between -10° C. and -11° C. the eggs of *Ephestia* are found to be destroyed in 18 hours but the number of eggs (2,826) used in those experiments (Section D3) is considered insufficient and further tests may raise or lower that limit. But the eggs of *E. kühniella* will withstand at least 72 hours' exposure to the same temperature. Therefore, if the times for the low temperature storage of tobacco are based on the results of the experiments on *E. kühniella*, as recommended in Section E5 (b), one can be sure that *E. elutella* and *Lasioderma* will be destroyed.

Other experiments were made by Runner upon insects living in manufactured tobacco. At a temperature of -8.9° C. to -10° C. (16° to 18° F.) all stages of *Lasioderma* were killed in his tests involving a period of over 5 days. At a fairly constant temperature of -10° C. (14° F.) all stages living in tobacco contained in sealed metal packages were killed in periods over 7 days. Use can be made of these results only in work involving the treatment of similar packages of tobacco as the time required for storage must depend upon the mass of tobacco to be treated and the nature of the containers.

Delassus and Lepige (1931) say that the beetle lives for some hours at -18° C. but do not mention if the insects were living in tobacco or exposed and unprotected. Powell (1932) records the survival of eggs after 20 days at 2° C. Zacher (1927) writing about control measures in Brazil, mentions that temperatures of -3° C. to -4° C., better -10° C., are used for a period of 22 days. Jones (1913) states that where cold storage is available all stages of the insect can be killed in 4 days at 8° C. In all these papers no mention is made as to how the insects were exposed to the given temperatures.

Skalov (1931) found that all stages of the insect were killed in 72 hours at -5 to -10° C. (23 – 14° F.). Adults were least resistant and succumbed after 24 hours at -9° C. (15.8° F.). Pupal were killed in 48 hours at -9° C. and eggs in 3 days at -5 to -9° C. After 6 days' exposure to a temperature of -3 to -6° C. (26.6 – 21.2° F.). larvae recovered at 25° C. An exposure of 2 days at -8° C. (17.6° F.) killed only 50 per cent. of the larvae.

Two experiments made by the writer on *Lasioderma* support the suggestion that the adults are less resistant to cold than the eggs and that they will also succumb to the temperatures lethal to *E. kühniella*. Of 9 beetles subjected to -6° to -7° C. for 1.9 hours, one survived whilst 7 out of 10 control insects lived. In another experiment in which 9 beetles were exposed to the same temperatures for 17.75 hours, all died. Three out of 5 controls were living at the termination of the experiment. The beetles were exposed in small glass tubes.

L.—GLOSSARY

(1) *Terms used in the Tobacco Trade and which are employed in the Report*

Air-cured Leaf.—Leaf which is cured in barns simply by regulating the ventilation. No artificial heat is used except sometimes during wet weather.

Bright and Dark Tobaccos.—Tobacco leaves after being cured are graded according to colour, size, etc. Leaves having a golden yellow colour are termed bright, those of a chocolate colour dark. There are grades between these two limits.

Butt.—The tied end of a "hand" of tobacco.

Fire-cured Tobacco.—Tobacco cured by application of heat and smoke.

Flue-cured Tobacco.—Leaf cured by heat alone.

Hand of Tobacco.—A number of tobacco leaves of similar quality tied together into a bunch by wrapping another leaf round the ends of the stalks.

Kiln-cured Tobacco.—Another name for Flue-cured leaf.

Resampling.—After being in use for some time samples tend to become dry and broken. They are then returned to the warehouse where they are repacked into the respective packages and new samples are drawn. The drawing of new samples is called resampling.

Sample.—After a package is weighed on receipt at the warehouse a number of "hands" of tobacco are taken from different parts of the package and made up into a bundle. This forms a sample and is retained by the merchant on his premises to give his clients an idea of the quality of the leaf contained in that particular package.

Sampling.—The process of making up samples.

Sample Room.—A room set apart by a merchant for the storage of his samples.

(2) *Entomological Terms which may confuse persons engaged in the Tobacco Trade*

Chemotropic Response.—A movement towards or away from a chemical substance which affects an insect through one or more of its sense organs.

Coleoptera.—The group of insects including all beetles; insects with two membranous wings folded up beneath two hard wing-cases.

Diapause.—A resting stage in the life history of an insect during which normal activities are suspended. A diapause is generally induced by physical factors of the environment, such as temperature or humidity.

Family of Insects.—A group of insects formed by assembling a number of related genera. (See Genus.)

Frass.—The mass of excreta and debris of foodstuff left behind by an insect. Where a larva of a moth has been feeding silken threads are intermingled with the excreta and debris.

Genus of Insects.—A natural group of insects comprising a number of allied species such as *Ephestia elutella*, *Ephestia kühniella* and *Ephestia cautella*, etc. (See Species.)

Hydrotropism.—A response made by an animal in moving towards or away from water.

Hymenoptera.—A natural group of insects which includes the ants, wasps, bees, sawflies, etc., which possess two pairs of membranous wings. Many small hymenopterous insects are parasitic on other insects.

Lepidoptera.—A natural group of insects which have four wings each covered with small scales. They comprise the moths and butterflies.

Life History of an Insect.—The stages passed through by an insect during its life cycle are egg, larva (grub or caterpillar), pupa (or chrysalis) and imago (or adult).

Mesophyll.—The tissue of a leaf lying between the upper and lower cuticles or superficial layers of cells.

Metabolism.—The chemical changes which take place within the cells in the body of an animal and which are responsible for growth, excretion of waste substances and liberation of energy.

Oviposition.—The act of depositing eggs.

Species.—A group of animals which bear a close resemblance to each other, the individuals of which can interbreed freely and produce offspring similar to themselves. The moths designated as *Ephestia elutella* form a species. *Lasioderma serricorne* is another species of insect.

Weevil.—A term often loosely applied to small beetles. Weevils form a group of insects resembling each other in certain characteristics among which the possession of a more or less elongated snout is the most evident.

H. H. S. BOVINGDON.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,
SOUTH KENSINGTON,
LONDON, S.W.7.

November, 1932.



PALESTINE ORANGE SHIPMENTS

REPORT OF AN INVESTIGATION BY THE ECONOMIC SECTION
OF THE EMPIRE MARKETING BOARD INTO THE
FACTORS INFLUENCING THE DEVELOPMENT
OF WASTAGE AND METHODS OF CONTROL



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PALESTINE ORANGE SHIPMENTS

I.—INTRODUCTION

In 1927 the Empire Marketing Board was approached by the Palestine Government for assistance in initiating a Fruit Inspection Service with the object of eliminating from orange shipments all fruit unsuitable for export and thus gradually raising the standard of quality. Accordingly two officers of the Board were seconded to the Palestine Government for the season 1927-28, and one for the season 1928-29; these officers were stationed at Jaffa and, in spite of considerable opposition in the early stages, were successful in establishing a workable scheme of inspection based on the South African model. The work has been continued since 1929 by the Horticultural section of the Palestine Department of Agriculture.

At the time the above scheme was initiated, the Empire Marketing Board was engaged in a systematic survey of the extent, nature and incidence of wastage in imported Empire fruit. Research into the diseases of fruit which cause wastage has long been in progress at experiment stations, in the main fruit producing countries, and a considerable body of data bearing on methods of control has been secured. Until recently, however, little exact knowledge was available of the causes and economic significance of wastage as it occurs in commerce, and the Board's survey was designed to obtain quantitative data as to existing conditions and to define the problems in which further research was of greatest urgency. Reports dealing with fruit shipments from Canada, Australia and New Zealand have already been published (2.3.4).*

The fruit inspection scheme was seen to afford an excellent opportunity of extending this work to Palestine oranges, which were known to show extensive wastage on arrival. It enabled observations to be made on the conditions obtaining in the groves, packing houses and quays in Palestine, thus enabling wastage observed on arrival at United Kingdom ports to be related to the pre-shipment treatment of the fruit. Further, by the courtesy of the shipping companies concerned, observations on temperature and other conditions in holds

* Throughout this report, figures in brackets refer to the list of references on page 44.

containing oranges were made throughout the survey. Data were, therefore, available of the conditions to which the fruit was exposed from the time of leaving the grove until its sale in the United Kingdom.

The presence of members of the Board's staff in Palestine also made possible a certain amount of experimental work, and a number of experimental shipments to test specific methods of control and factors influencing wastage were made during both the 1927-28 and 1928-29 seasons. Much of this work, particularly in the latter season, was carried out in co-operation with the Palestine Department of Agriculture and the Tel Aviv Experimental Station near Jaffa, and investigations on fruit rots have since been continued at the latter Station with financial assistance from the Empire Marketing Board. Throughout the survey close contact was also maintained with the officers of the Cambridge Low Temperature Research Station of the Department of Scientific and Industrial Research, particularly in connection with the Department's study of wastage in Covent Garden Market.

The investigational methods followed in this country were essentially the same as those described in previous reports. Most of the work was carried out at the docks, as experience has shown that an extensive examination of imported fruit can be most conveniently undertaken at that point. The fruit is there concentrated into a comparatively small area and facilities for opening the packages are readily obtainable. After unloading, shipments were examined as thoroughly as possible before removal from the dock, notes being taken of the origin, quality and maturity of the fruit, the nature and extent of any wastage present and any further observations that appeared to be of interest. In addition, ships were boarded during unloading and observations taken of the temperatures of the holds and the methods of stowage of the cargo.

During the 1927-28 and 1928-29 seasons, shipments of Palestine oranges were regularly examined on arrival at the ports of London, Liverpool, Glasgow and Manchester and occasionally at Hull. In the two subsequent seasons a more limited dock examination was undertaken, and no attempt was made to cover more than a small proportion of the shipments. The following report, therefore, relates mainly to the period 1927-29, but there has since been little change in the conditions of the industry and the data and recommendations based on the earlier part of the investigation are still generally applicable.

II.—THE PALESTINE CITRUS INDUSTRY

Palestine is rapidly growing in importance as a producer of oranges and has now attained the fourth place among orange exporting countries, surpassed only by Spain, Italy and the United States. The area under cultivation more than doubled between the years 1924 and 1928 and planting is still in progress. A very considerable increase in orange production may therefore be expected as the more recently planted trees come into bearing. The greater part of the crop is shipped to the United Kingdom, notably to the northern ports of Liverpool, Glasgow, Manchester and Hull, but in recent years increasing quantities have been despatched to other British ports and to the continent of Europe. The export season normally lasts from October to April inclusive, the greater part of the fruit going forward from December to March. Shipments are not at present made later than April because of the severe losses usually incurred towards the end of the season through the Mediterranean fruit fly. At the beginning of the season, considerable quantities of oranges are railed to Egypt and shipped from Port Said, but from the middle of November onwards practically the whole export to Western Europe is shipped direct from Jaffa on vessels carrying oranges as the main part of their cargo.

The following table shows the imports of boxed oranges during the past five seasons. In addition, considerable quantities of fruit were until recently consigned in bulk to Egypt; these largely consisted of second quality fruit. The equivalent of 190,000 boxes were disposed of in this way during the 1926-27 season, while bulk imports during the two following seasons corresponded to some 50,000 boxes.

Type of Orange

Practically the whole export consists of one variety, known as the "Shamouti" or "Jaffa" orange. Typically, this is a fine quality fruit of good size and characteristic oval shape. It is extremely juicy, of good flavour and remarkably free from "rag," except in the earliest shipments, when the fruit is not fully ripe. Early shipments are also commonly rather pale, but later the fruit acquires the deep orange colour preferred on the British market.

There is also a strong market preference for oranges with thin skins of fine texture. The Shamouti orange varies considerably in this respect. Thin skinned strains are fairly common, but on the whole

the variety tends towards a rather thick skin, and some types develop very coarse, thick rinds which are often badly ribbed and corrugated. Members of the trade state that these thick skinned types have been shipped in increasing quantities during recent years to the detriment of the reputation of the Jaffa orange. It appears very desirable that such oranges should as far as possible be eliminated from export consignments by rigorous grading and that efforts should be made to standardise the best type of Shamouti orange by careful bud selection. It also appears desirable not to propagate strains which tend towards a spherical rather than the more usual oval shape, since the characteristic shape of the Jaffa orange is a definite commercial asset, enabling it to be easily recognised by consumers and thus in effect acting as a form of trade mark.

TABLE I.—Exports of Oranges from Palestine (Boxes)

Destination.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.
United Kingdom—					
Liverpool	637,411	614,525	423,886	585,565	585,381
Glasgow	417,865	393,162	261,146	384,332	354,622
Manchester	306,106	291,913	204,368	344,171	233,832
Hull	303,418	236,084	168,451	341,825	221,227
London	154,811	141,896	141,716	254,486	241,795
Southampton		27,651	19,472	28,300	25,749
Cardiff		23,988	28,663	52,732	47,101
Bristol	84,638	—	5,293	—	—
Newcastle		—	5,800	—	6,991
Belfast		—	—	6,027	8,570
Total to United Kingdom	1,904,249	1,729,219	1,258,795	1,997,438	1,725,268
Germany	66,349	141,541	190,857	421,022	510,412
Roumania	33,571	51,852	37,276	39,385	42,829
Netherlands	—	32,623	33,807	35,554	12,243
France	—	8,897	17,770	11,557	7,189
Bulgaria	996	2,679	8,504	5,294	6,937
Scandinavia				42,769	84,175
Austria				3,500	10,736
Poland				1,785	6,008
Czecho Slovakia	9,909	24,460	29,134	1,995	5,000
Switzerland				2,907	5,452
Belgium				2,341	2,913
Hungary				1,005	1,920
Yugo Slavia				—	4,067
Total to Continent	110,825	262,052	317,348	569,114	699,881
Various other destinations	9,656	4,924	4,401	129,309	41,840
TOTAL	2,024,730	1,996,195	1,580,544	2,695,861	2,466,989

Cultural Conditions

For detailed information on the methods of orange cultivation adopted in Palestine, reference should be made to Clark Powell's report on the Palestine Citrus Industry (6) and to various articles in "Hadar." The greater part of the export crop is grown in the area immediately surrounding the Port of Jaffa, where conditions are particularly favourable to export growing. Frost is almost unknown and no protection by orchard heating is necessary. Soils vary from a light sand to a heavy loam and irrigation is generally employed. Two types of stock are in use, the sour orange and the sweet lemon. The latter comes into bearing earlier and is the more frequently planted, but the sour orange stock is, on the whole, more vigorous, longer lived and more resistant to gummosis.

A striking feature of Palestine groves is the very small distance between the trees which are often planted no more than 10 to 13 feet apart. A comparatively high yield per acre is secured, but many authorities consider that if spaced to some 18 to 20 feet apart the increased production from each tree would more than counterbalance the loss through the reduction in the number of trees. Further, the close planting considerably increases the difficulty of cultivation and maintenance of the grove. Cultivation is mainly carried out by hand labour and in many groves the methods of culture employed have not changed appreciably since the last century.

Methods of harvesting are considered below in Section V.

Packing

The oranges are packed in wooden boxes, which are divided into two compartments by a centre partition. They are constructed of fairly thick wood and additional strength is given by bands of green wood nailed round the two ends and the middle of the box. Small quantities of oranges are also shipped in flat half-cases of similar construction.

It has been suggested by members of the fruit trade that it would be advantageous to employ the Valencia type of case, which is very open in construction and allows a fair impression to be gained of the condition of the fruit without opening the box. This case is rather lightly constructed and might not withstand the somewhat rough handling at the port of Jaffa, where fruit often has to be loaded in a rough sea. It appears, however, that experiments might well be tried with a case similar in size to the present case, but with top, bottom and sides made of two or three spaced strips equal in thickness to the

boards now employed. This would effect a considerable economy of wood, while the boxes themselves would be appreciably lighter and better ventilated.

Palestine oranges are packed according to two systems, known as the "Jaffa" and "American" packs respectively. The former is the older system and is still the more widely used. The oranges are arranged rectangularly across the box with their cheeks in contact and the sizes are packed in each box in alternate layers of large and small oranges. Thus in the "144," the most common Jaffa count, each compartment contains two layers of sixteen large oranges arranged in four rows of four, alternating with two layers of twenty small oranges arranged in four rows of five.

In recent years, however, increasing quantities have been packed according to the "American" system; this is the well-known diagonal pack in which all the oranges in a box are uniform in size.

Opinions differ as to the respective merits of the two packs. There is a large conservative element in favour of the Jaffa system, but the diagonal pack is more in accordance with the modern tendency towards size uniformity and may be expected gradually to supplant the older method. Importers state that some shippers use the Jaffa pack as a method of disposing of excessively large oranges, and there is also a general impression that fruit is less likely to bruise in the diagonal pack where each orange fits into the hollows of the underlying layer instead of resting directly on the cheeks of the underneath fruits. Further, the majority of retailers prefer a uniform pack which obviates the necessity of sorting the fruit for sale and makes it easier to calculate retail prices. On the other hand, it is urged that there is a demand for the mixed Jaffa pack on a market short either of large or of small sized oranges, and that small retailers often prefer a pack which provides two sizes of fruit from one box.

III.—CONDITIONS OF TRANSPORT

With the exception of comparatively small quantities railed to Port Said for shipment, all Palestine oranges were until recently exported through the port of Jaffa. Loading conditions at Jaffa are, however, difficult: serious delays are often caused by rough seas and consignees frequently have cause to complain of shipment arriving "short" or in a damaged state. Increasing use is therefore

being made of the recently developed, but less central port of Haifa, and in the past season (1930-31) over half a million boxes were exported by that route, mainly to the continent of Europe.

Individual orange shipments usually consist of some 20,000 to 35,000 boxes and constitute the main part of the cargo, although wool, locust beans and other commodities are often carried in the same holds as the fruit. Most vessels engaged in the trade are fitted with 'tween decks and the fruit is stowed both in these and in lower holds. Many exporters prefer to ship their fruit in the former position, partly because cases stowed there are likely to be the first unloaded and thus find an early market, partly because it is believed that ventilation and temperature conditions are more satisfactory there than in lower holds. Vessels often sail with the 'tween decks filled, but with no more than five or six tiers of cases in the holds, particularly in short crop seasons. In any case, boxes are rarely stowed to a greater height than 8 or 10 tiers, although 12 or 15 tiers have been noted occasionally, mainly in vessels without 'tween decks.

The cases are usually stowed on their sides or bottoms, but there is no standard method and an upright "on-end" position is sometimes adopted. No dunnage is placed between the boxes, but in lower holds vertical gaps about a foot wide are sometimes left in the stowage at intervals of eight to ten cases to facilitate ventilation of the lower part of the cargo. Further, the cargo is held about a foot away from the sides by wooden battens.

All the vessels examined were provided with funnel ventilators leading to both holds and 'tween decks and in some instances these were fitted with fans to maintain a flow of air. Refrigeration is never employed and is generally considered to be unnecessary in view of the shortness of the voyage which normally occupies two or three weeks. It is nevertheless certain that the conditions of transport, more especially as regards temperature and humidity, will have a considerable influence on the development of wastage, and data were therefore collected on the conditions obtaining in ships' holds.

Temperatures were investigated in two ways; the temperatures of many cargoes were determined at the time of loading and on arrival in the United Kingdom, and self-registering thermometers (thermographs) were installed in several holds to record the temperatures obtaining throughout the voyage. These instruments only became available in small batches towards the latter part of the 1927-28 season, and in that season one or two were installed in several

cargoes to obtain comparative data for a number of vessels. In the following season all the thermographs available were shipped in one vessel to gain some idea of the temperature distribution in different parts of the cargo.

No direct measurements of humidity were made, but from general observation it appears that the humidity is usually high, as would be expected in view of the constant transpiration of water vapour from the fruit and the somewhat limited ventilation possible in some holds. As a rule, the atmosphere is very close when a hold is first opened, while considerable quantities of condensed moisture are often present on the roof and sides of the chambers where local cooling has taken place. In some instances this is so extensive that the upper cases are soaked by "drip" from the roof.

Temperature Conditions in the Holds

At the time of shipment it may be taken that the fruit in all parts of a vessel is comparatively uniform in temperature. Variations in the treatment of the fruit before loading may produce temperature differences as between individual boxes or even "marks," but in the holds boxes are stowed indiscriminately as regards origin and the immediate tendency of the juxtaposition of the warmer and cooler fruit would be to equalise temperatures. Observations taken during loading indicate that the temperature of the fruit at that time is usually of the order of 62°—68° F., though readings as high as 70° and as low as 55° have been recorded.

On arrival, however, wide temperature variations are found, differences of as much as 20° F. in one cargo being by no means unusual. The highest temperatures recorded have been in the neighbourhood of 72°—73° F., and such readings are comparatively common; 44°—48° F. are the lowest figures normally occurring, although temperatures well below 40° F. were noted during the widespread cold weather in February, 1929. A range of 50°—65° F. may perhaps be taken as an average, but the differences between individual shipments on arrival are very considerable. Further shipments with similar ranges may differ widely in average temperature according to the relative proportion of the cargo at each part of the temperature scale.

Little seasonal variation in the average temperature of shipments on arrival has been noted, except that there is a tendency for fairly high temperatures to occur in the last few cargoes at the end of

PALESTINE ORANGES.

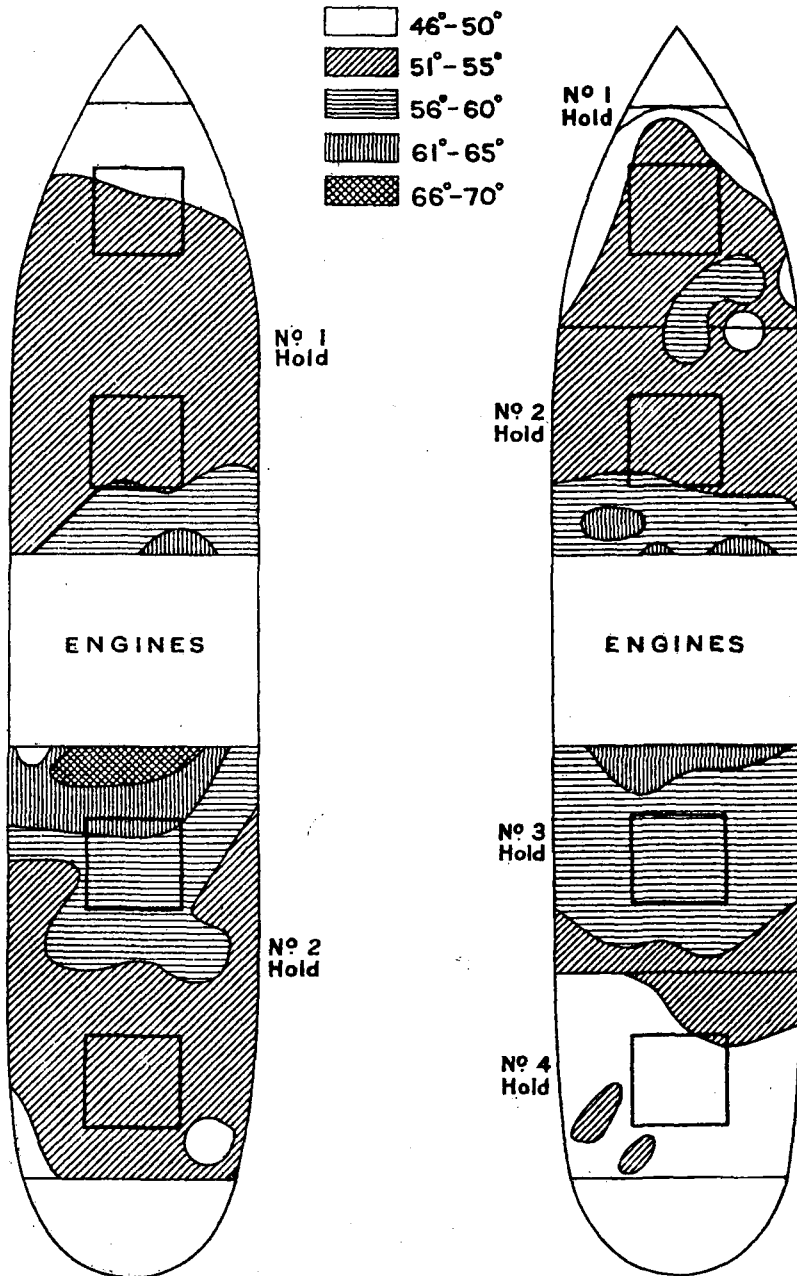


FIG. I

FIG. II

March and in April, while as noted above, several shipments showing unusually low temperatures arrived during the extremely cold weather in February, 1929.

From comparison of readings from a large number of cargoes, it appeared that there was a certain measure of regularity in the temperature distribution, which in many shipments conformed more or less closely to the type shown in Figures I and II.

Figure I represents the temperature conditions in a vessel without 'tween decks in which the entire hull fore and aft of the engine room constituted two large holds ; this was the simplest type of "lay-out" encountered. Oranges were present in both holds to a depth of about 12 tiers of boxes, most temperatures shown in the diagram being taken some five or six layers from the top of the cargo. Figure II shows the temperatures in the lower holds of a vessel fitted with 'tween decks. In this case, both the fore and aft sections of the vessel were divided into two holds by cross bulkheads, and the holds were also divided longitudinally as far as the hatchways by partitions running fore and aft. Six to seven tiers of boxes were stowed in the holds, and most temperature readings were taken in the upper part of the cargo.

It will be observed that in both cases the temperature distribution was essentially similar. At the extreme ends, both fore and aft, temperatures below 50° F. were recorded, a considerable area further inwards was at a temperature between 50° and 55° F., while towards the centre the temperatures rose more rapidly, readings approaching 70° F. being obtained in the neighbourhood of the engine room bulkheads. The isotherms are by no means regular, however, and complete regularity would scarcely be expected since there must always be variations in the ventilation, closeness of stowage and similar factors ; further, all the temperatures were not taken at exactly the same vertical level. It may also be noted that a considerable time is occupied in making a large number of temperature records during which appreciable cooling may take place.

In these vessels no readings were taken directly beneath the hatchways, conditions of working rendering it impracticable ; readings in this neighbourhood taken in other vessels before or during breaks in unloading gave varying results. In some instances, cooler areas were found, mainly in 'tween decks, but in others there appeared to be no appreciable temperature differences as compared with other

parts of the cargo ; presumably the determining factors are the atmospheric temperature and the extent to which it is possible to leave the hatches open during the voyage.

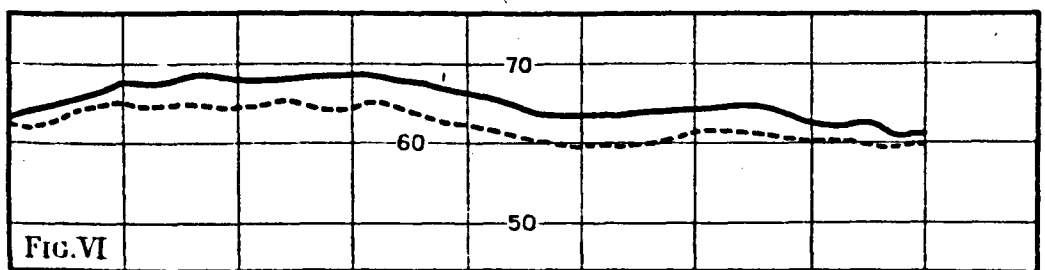
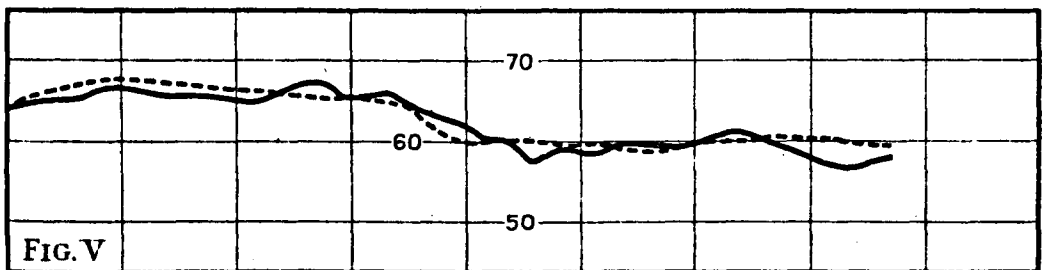
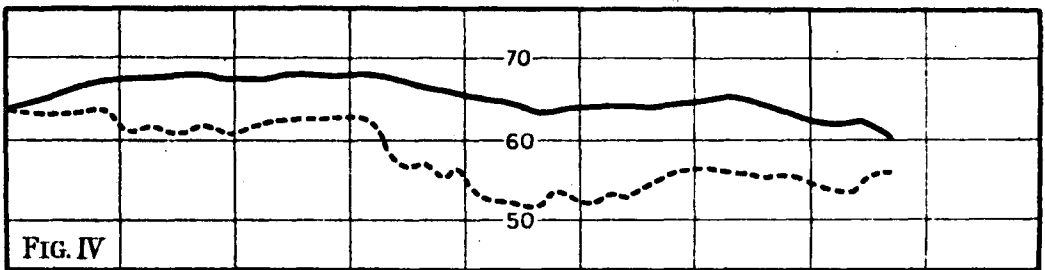
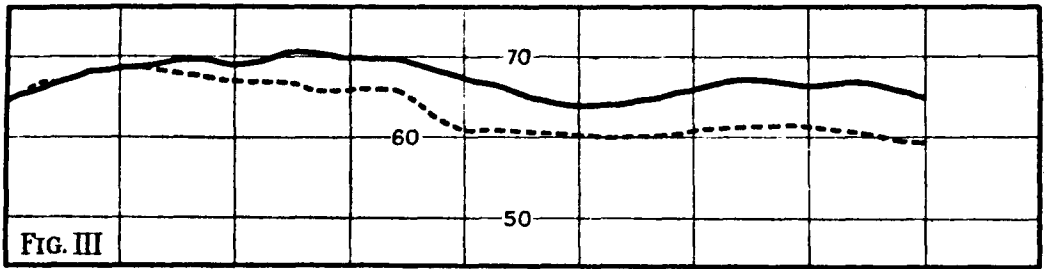
The fore and aft temperature variation is also illustrated by the thermograph charts reproduced in Figures III and IV. These instruments were placed in comparable positions in a 'tween deck and lower hold immediately aft of the engine room, i.e., in chambers corresponding to No. 3 hold in the vessel illustrated in Figure II. In all cases they were about midway between the centre and the starboard side of the ship and roughly equidistant from the top and bottom of the cargo, but those shown by continuous and dotted lines were slightly fore and aft respectively of the hatchways. In both 'tween deck and lower hold, wool was stowed in the potentially warmest position immediately against the engine room bulkheads, and the positions chosen were not such as to display the maximum temperature variation. Nevertheless in both cases the temperatures recorded by the instruments nearer the engine room bulkhead, were, after the first few days, several degrees higher than those further aft.

Comparison should also be made with Figure V, which reproduces the records from the foremost 'tween deck thermograph and from an instrument in a corresponding position towards the port side of the vessel. It is seen that there is practically no lateral variation in temperature, almost identical temperatures being registered by both instruments throughout the voyage. Similar results were obtained in the aft part of the 'tween deck and in both fore and aft positions in the lower hold.

In addition to the horizontal temperature variation, a smaller vertical variation was observed, and in most shipments the upper part of the cargo being somewhat warmer than the lower part. The difference in a chamber containing some six or eight tiers of boxes was usually of the order of 3°-4° F. The uppermost layer of boxes forms an exception to this general rule on account of surface cooling, and the highest temperatures were usually found in the second layer from the top. Thermograph charts taken at two vertical levels are reproduced in Figure VI. That shown as a dotted line was obtained in the bottom layer of the hold and throughout the voyage the temperatures are seen to have been two or three degrees lower than in the second chart which was taken from an instrument four tiers vertically above the first.

RECORDS OF TEMPERATURES IN THE HOLDS OF VESSELS
CARRYING PALESTINE ORANGES.

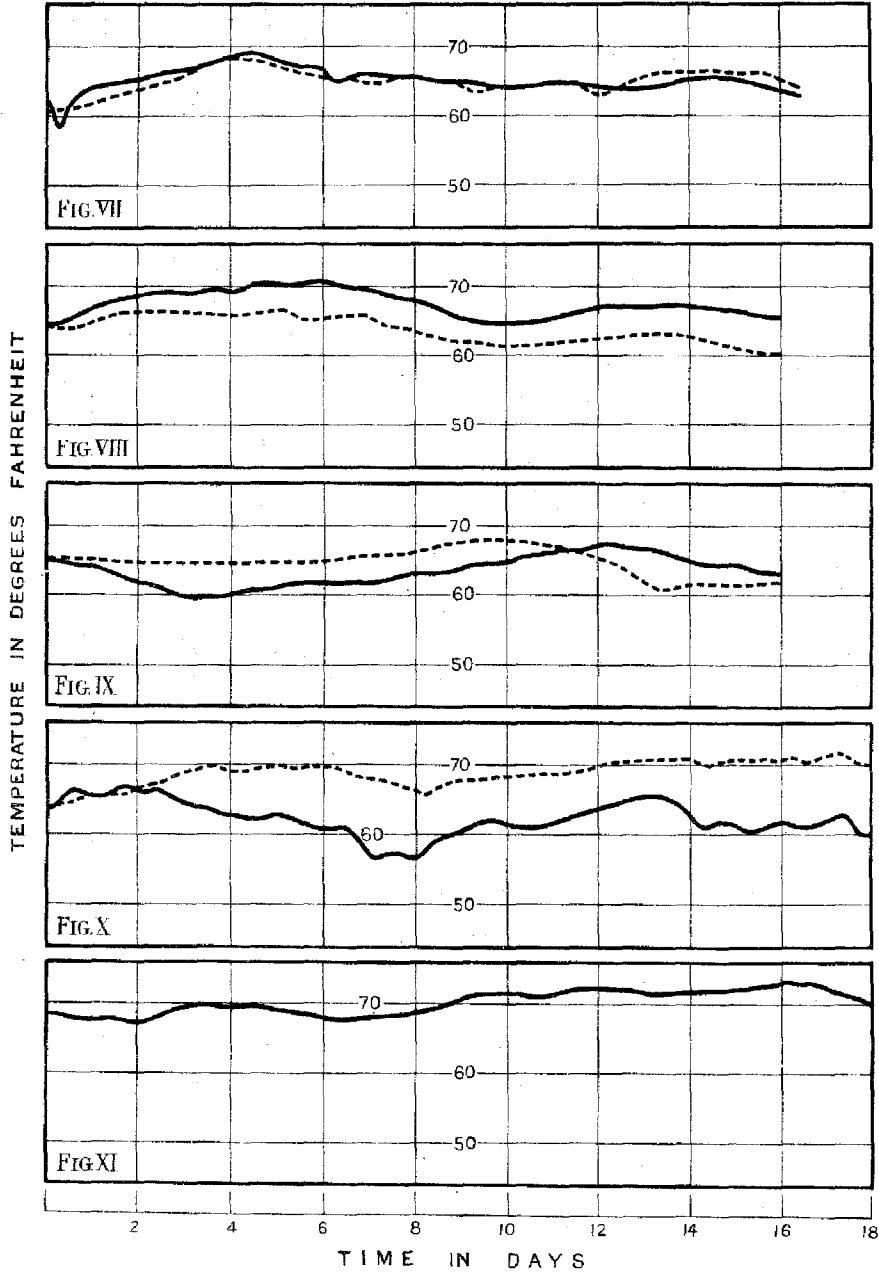
TEMPERATURE IN DEGREES FAHRENHEIT



2 4 6 8 10 12 14 16 18

TIME IN DAYS

RECORDS OF TEMPERATURES IN THE HOLDS OF VESSELS
CARRYING PALESTINE ORANGES.



In connection with the vertical temperature variation it is of interest to compare the temperature obtaining in 'tween decks and lower holds, since many Palestine growers prefer to ship their fruit in the former position, partly because it is considered that there ventilation is more satisfactory and temperatures lower. Where weather conditions have enabled the hatchways to be left uncovered during a considerable part of the voyage it seems likely that this would be the case. From observations, however, it does not appear that any general rule can be formulated. Cases have been encountered where the 'tween decks were somewhat cooler on arrival than the lower holds, but the reverse has also been noted, while more frequently there appears to be no marked differences between the two. Thermograph charts from comparable positions in the 'tween decks and lower holds of certain vessels are reproduced in Figures VII-X and illustrate the absence of any general tendency. In all cases the continuous lines represent temperatures in 'tween decks and dotted lines temperatures in lower holds.

It is evident from the foregoing paragraphs that the variation of temperature in time during the voyage will differ widely in different parts of the cargo. The thermograph charts reproduced in Figures III-VI were mainly taken in areas where the temperature on arrival did not differ greatly from the average, and in general show readings a few degrees lower at the end than at the beginning of the voyage. No satisfactory records were secured in positions where the lowest temperatures are recorded on arrival and it is uncertain how early in the voyage the cooling process takes effect. Figure XI shows a chart from a high temperature area where a fairly regular rise was recorded until almost the end of the voyage.

Combining the information available, however, it appears that in most instances the temperature of the bulk of an orange cargo falls slowly during the voyage and on arrival is some 5° to 10° F. lower than at the time of loading. In the absence of definite cooling facilities, this may perhaps be regarded as a not unsatisfactory result.

Factors Influencing Temperature

The observations on temperature distribution suggest that the cooling action of the sides of the ship is at present the most important agency in reducing the temperature of Palestine orange cargoes. Cool air in the space between the cargo and the sides would tend to sink towards the bottom of the hold, there displacing warmer air

and causing it to rise through the interstices of the cargo. A slow convection current would thus be set up, exerting its greatest influence at the sides and in the lower part of the cargo, where the cool air first comes into contact with the fruit, and in the extreme fore and aft positions where cooling would be facilitated by the narrowing of the hold.*

The frequency with which high temperatures are found in the neighbourhood of the engine room bulkhead suggests that there is often a leakage of heat into the hold at this surface ; many instances have in fact been observed where these bulkheads were perceptibly warm to the touch. In some vessels an empty space one or two feet wide is left in this position to protect the fruit ; in others less perishable cargo is stowed immediately next the bulkhead and when, as is usual, this consists of some non-conducting material such as wool an effective measure of insulation is obtained. Very frequently, however, the boxes are stowed in direct contact with the warm bulkhead. Leaving an empty space does not in itself appear to constitute an adequate protection for the fruit, and as it may often happen that no alternative cargo is available as an insulating inter layer, the most satisfactory method of avoiding high temperature areas may lie in covering the engine room bulkheads with a layer of slab cork or other insulating material.

In all the vessels examined, ventilation was applied by means of funnel ventilators, sometimes furnished with fans, opening into the roofs of 'tween decks and lower holds. No attempt is made, however, to lead the cool air into the interior of the cargo, except that in lower holds vertical gaps about a foot wide and running transversely across the ship are sometimes left in the stowage at intervals of eight or ten cases.† It therefore appears that the main effect would be to produce a flow of cool air over the top of the compact mass of cases leaving the air actually in contact with the bulk of the cargo relatively undisturbed. A considerably greater cooling effect could probably be obtained by modifying the system of ventilation, but

* Any temperature inequalities produced in this way would be intensified by the self-heating of the fruit, since heat development is greater at high than at low temperatures.

† It is probable that these spaces are of some value, although it has not been possible to secure any definite evidence as to their effect on the temperature conditions. It may be noted, however, that vertical air spaces were left in the cargo represented in Figure I and it is thus evident that their presence is not incompatible with fairly high temperature in some parts of the cargo.

it would be premature to make definite recommendations until the investigations into methods of cooling large masses of fruit now in progress at the new Ditton Experimental Station have reached a more advanced stage.

IV.—CONDITION ON ARRIVAL

Selection

On arrival, there is often serious wastage in Jaffa oranges, and most shipments are therefore "selected" by the consignees immediately after unloading. Long benches are erected in the dock sheds on which the boxes are opened for examination, all decayed oranges are thrown out, and the boxes are classified according to the following scheme :—

0-2 per cent. wastage	..	I (one chalk or sound).
2-5 per cent. wastage	..	II (two chalks).
5-10 per cent. wastage	..	III (three chalks).
10-25 per cent. wastage	..	X (small cross).
25-50 per cent. wastage	..	XX (large cross).
Over 50 per cent. wastage	..	Wasty.

Each box is then catalogued for sale in accordance with its classification.

This procedure is followed by most consignees at the ports of Liverpool, Glasgow, Manchester and Hull, except for the first few shipments of the season which are normally in fairly good condition. In these shipments a sample number of boxes from each "mark" are examined, but only those showing appreciable wastage are selected in detail. The modification has also been recently introduced at Liverpool of making up boxes classified in Chalk II with sound fruits and during the past season this practice has also been adopted at the other Northern ports. At London, some firms follow the above procedure of selection, while others transport the fruit to warehouses where it is either "selected" in the ordinary way or re-packed as sound.

The process of selection obviously adds considerably to the cost of marketing Palestine oranges. Further, it appears inevitable that some fruits should sustain mechanical injuries during the hurried examination and repacking, although as a rule great care and skill are exercised by the selectors. More serious is the fact that if many decayed oranges are removed the remaining sound fruits are naturally re-packed very loosely and are thus liable to severe movement

and injury during subsequent transportation. Such injuries would render the fruit more susceptible to rotting, and are likely to be followed by increased wastage. An experiment to test the influence of this procedure on the post-shipment development of wastage is described below in Section V.

While Jaffa oranges continue to arrive in their present variable condition, however, the only alternative to selection lies in re-packing all boxes as sound.* This procedure is already adopted with grapefruit, but shipments of Jaffa oranges are on a much larger scale and the work involved would be enormous, particularly since many boxes contain fruit of two sizes. Nevertheless, it may well be that this additional expense would be more than compensated for by reduced post-shipment wastage.

Extent of Wastage

Clark Powell (6) states that "the usual amount of decay of fruit in transit is from 10 per cent. to 25 per cent. and is occasionally more," while estimates given by members of the trade are usually of the same order. It is believed, however, that these figures are too high, since even in the most wasty cargoes a high proportion of the fruit is classified as "sound" or "two chinks."

The selection classification appears to afford a definite basis for an estimate of the extent of wastage, since at the ports of Liverpool, Glasgow, Manchester and Hull, some 70 per cent. of the total imports are catalogued for sale by auction according to this scheme. This fruit constituted over 40 per cent. of the total exports of Palestine oranges during the period under review and may probably be taken as a representative sample. An analysis was therefore undertaken of the auction catalogues published at the above ports during the seasons 1927-28† and 1928-29 and the number of boxes classified in each wastage group was determined for each individual shipment. With few exceptions, the figures were taken from the priced catalogues published after all the fruit had been sold. The figures obtained are set out in Appendices A and B. Somewhat similar analyses for the seasons 1929-30 and 1930-31 were published in

* It is sometimes claimed that if a more open case of the Valencia type were employed for Jaffa oranges it would be possible to gain an adequate impression of the condition of the fruit without opening the box. This, however, is doubtful in view of the very serious wastage occurring in some boxes.

† The data given for the 1927-28 season do not include shipments to Hull.

"Hadar," and these are reproduced in Appendices C and D; the latter tables show only the percentage of boxes catalogued in each wastage group.

From the analysis figures for the 1927-28 and 1928-29 seasons, a rough estimate was made of the overall percentage of wastage in each shipment, on the assumption that the average wastage in each group was equivalent to the mean of the limiting percentage of wastage for the group. For example, the average wastage in Group I (0 to 2 per cent. wastage), was taken as 1 per cent., in Group II (2 to 5 per cent. wastage) 3.5 per cent., and so forth. On this basis a weighted average of wastage was calculated for each individual shipment and for the whole season. Similar averages were worked out for those shipments during the two later seasons which were selected by the older system, but the method of calculation is inapplicable to shipments in which boxes classified in Group II were re-packed as sound.

It is seen that the calculated values are substantially lower than those quoted above; the average for the whole season being of the order of 5 per cent. of wastage. The highest proportion of wastage in any shipment was 13.4 per cent., and estimates higher than 10 per cent. were obtained on three occasions only.

Several objections may be raised against basing estimates of wastage on selection data, but it is believed that in view of the very large sample covered the results are fairly reliable. In support of this statement it may be noted that comparable figures have been obtained for the four ports included in the analysis; further, in individual shipments the returns by different brokers are usually in good agreement.

Although considerably lower than the usual estimates, it should be emphasised that 5 per cent. of wastage constituted a very serious loss. Thus, on an export of two million cases, it represents 100,000 cases of decayed fruit. It should also be borne in mind that the depreciation in price is likely to be greater in proportion than the wastage. A rough attempt was made to estimate the financial loss due to wastage during the 1928-29 season on the basis of the catalogue analysis. Each shipment was considered separately and the average price realised by boxes in each wastage group calculated, due weight being given to the various counts. From these figures were calculated (i) the approximate value of the fruit catalogued and (ii) the approximate value had all cases been sound and sold for the prices actually realised for sound fruit. The difference between (i) and (ii) was taken as a rough measure of the financial loss.

On this basis, an estimate of £539,000 was obtained for the total value of the fruit catalogued during the 1928-29 season, and £62,000 as the loss due to wastage. In proportion, the loss on the whole season's shipment of approximately 1,500,000 boxes (Table I) would amount to £135,000.

It may be objected that the price realised by sound fruit was enhanced by its scarcity value and would have been less if the whole of the fruit had arrived in good condition. Against this, however, it is to be remembered that if Palestine oranges could be relied on to remain sound it is likely that the increased confidence of buyers would bring about higher prices all round.

Nature of Wastage

Nearly all the wastage found in Palestine oranges is due to rotting by various fungi. The most serious losses are caused by species of *Penicillium* and these probably account for 90 per cent. of the total wastage. Green mould (*P. digitatum*) is the more common, but blue mould (*P. italicum*) is the predominant form in some "marks" and appears to be relatively more important in post-shipment rotting. The somewhat unripe oranges in the earliest shipments are fairly resistant to these fungi, but as the season advances and the fruit becomes more mature rotting by both green and blue moulds increases. In the early stages of infection the two rots closely resemble each other, a small, soft, water-soaked, slightly sunken area appearing on the skin.

In the case of green mould, the affected area rapidly enlarges, after a white mould growth appears on the surface, followed later by the development of olive-green spore masses in the middle of the white growth. Ultimately the whole fruit may be covered with green spores. The stage of the injury in which a fairly large portion of the skin is soft and water-soaked but before any superficial mould growth appears is known in the fruit trade as "butter waste."

The small sunken spot due to an early stage of blue mould decay usually enlarges more slowly. After a time white mould growth appears on the surface, followed closely by the production of greenish blue spore masses so that there is only a narrow band of white mycelial growth surrounding the sporing area. A wide band of soft, decayed rind which has not yet developed any surface growth is generally found at the surface of the injury.

These last characteristics serve to distinguish blue and green moulds, since in the latter injury a wide band of white mould growth usually surrounds the sporing area, while there is only a narrow fringe

of soft tissue without surface growth at the edge of the rot. Another distinction is that green mould only forms spores at the surface, while in advanced rots blue mould spores often appear at the core of the orange. The behaviour of the wrapping paper also affords a clue, sticking closely to the decayed fruit in the case of green mould, but not adhering at all readily to a blue mould decay.

In the early shipments, the only serious wastage is a type of stem end rot caused by the fungus *Diplodia natalensis** and known in the trade as "water-logging" or "black-ball waste" according to its stage of development. This injury originates in the grove and is less widespread in its incidence than green or blue mould, being practically absent from some "marks." *Diplodia* rotting becomes less common as the season advances and is rarely serious in shipments arriving after Christmas, though it sometimes increases again at the extreme end of the season. The decay first appears as a leathery, brown discoloured area in the neighbourhood of the stem end or "button." At fairly warm temperatures it enlarges fairly quickly and often unevenly, brown fingers of decay extending into the healthy rind. The rot also spreads rapidly through the core and makes its appearance at the lower or styler end of the fruit, which then appears to be affected at both ends. The two areas then grow together till the whole fruit is involved. In the final stages of the disease the brown leathery skin darkens and ultimately turns black. An affected orange in its final stage may be jet black all over, but otherwise normal in appearance since the fruit does not become specially soft or disintegrated unless very mature, and no surface mould growth appears. The rot is often accompanied, however, by an exudation of sticky juice over the skin and by a characteristic smell of decay. Secondary rotting by *Penicillium* is fairly frequent.

Other types of wastage are less common. A certain amount of rotting by *Alternaria citri* has been observed, and towards the end of the season mature fruit is often disfigured by dry, brown, leathery surface rotting due to *Colletotrichum gloeosporides*; the same fungus often attacks oranges stored for some time after unloading. The injury is confined to the rind, however, and is not as a rule followed by any secondary rotting. Affected oranges are therefore quite eatable and are not as a rule discarded during selection. Some skin disfigurement is also caused by scale insects and by "sooty mould"

* *Phomopsis* sp. which produces a brown stem end rot similar to that due to *Diplodia* has also been reported in Palestine oranges (9).

(*Capnodium citri*) a fungus which grows not on the fruit tissue itself, but on a "honeydew" secreted on the rind by aphids and scale insects.

The principal types of wastage mentioned above are discussed in greater detail in Section V below. Reference should also be made to various papers on Palestine fruit rots published in "Hadar" by Reichert and his co-workers at the Tel-Aviv Experiment Station.

Seasonal Incidence of Wastage

The seasonal incidence of wastage is brought out clearly in Fig. XII, which shows the percentage of boxes classified in the selection Groups X, XX and Wasty (i.e., containing more than 10 per cent. of wastage) in all shipments for which data are available in the seasons 1927-31. This method of presentation was adopted to secure comparable data for the four seasons, since it is not possible to estimate the actual percentage of wastage in cases when fruit classified in Group II was repacked as sound.

In all cases the shipments are arranged in order of dates of sailing, and it is at once evident that in three of the seasons under review there was a definite but irregular rise in the extent of wastage as the season advanced, reflecting clearly the increased susceptibility to *Penicillium* rotting as the fruit ripens. The 1929-30 season, however, forms an exception to this tendency. In that season the first nine shipments arrived in sound condition, but thereafter followed a period of extensive wastage of a severity that would not normally have been anticipated until a later stage in the season. In comparison, the final shipments were in remarkably good condition. The explanation of this unseasonable wastage appears to have been a puffiness of the skin which affected a large proportion of the crop at the time, rendering it extremely liable to fungal invasion; this injury was attributed locally to the very heavy rainfall experienced during December, 1929.

Variation in Wastage as between Individual Shipments

Although the influence of maturity on wastage is clearly indicated in Fig. XII, it is evident that other factors are also of importance, since shipments made at the same stage of the season vary widely in condition on arrival. Examination of the selection data indicates that to a large extent these variations apply to all sections of the cargo, in that on a "bad" boat nearly all marks show more than the average wastage. This is well illustrated by the following table showing the percentage of wastage in a number of marks in five successive shipments.

WASTAGE IN PALESTINE ORANGES

FIG. XII

Percentage of boxes in successive shipments classified as more than 10 per cent wasty.

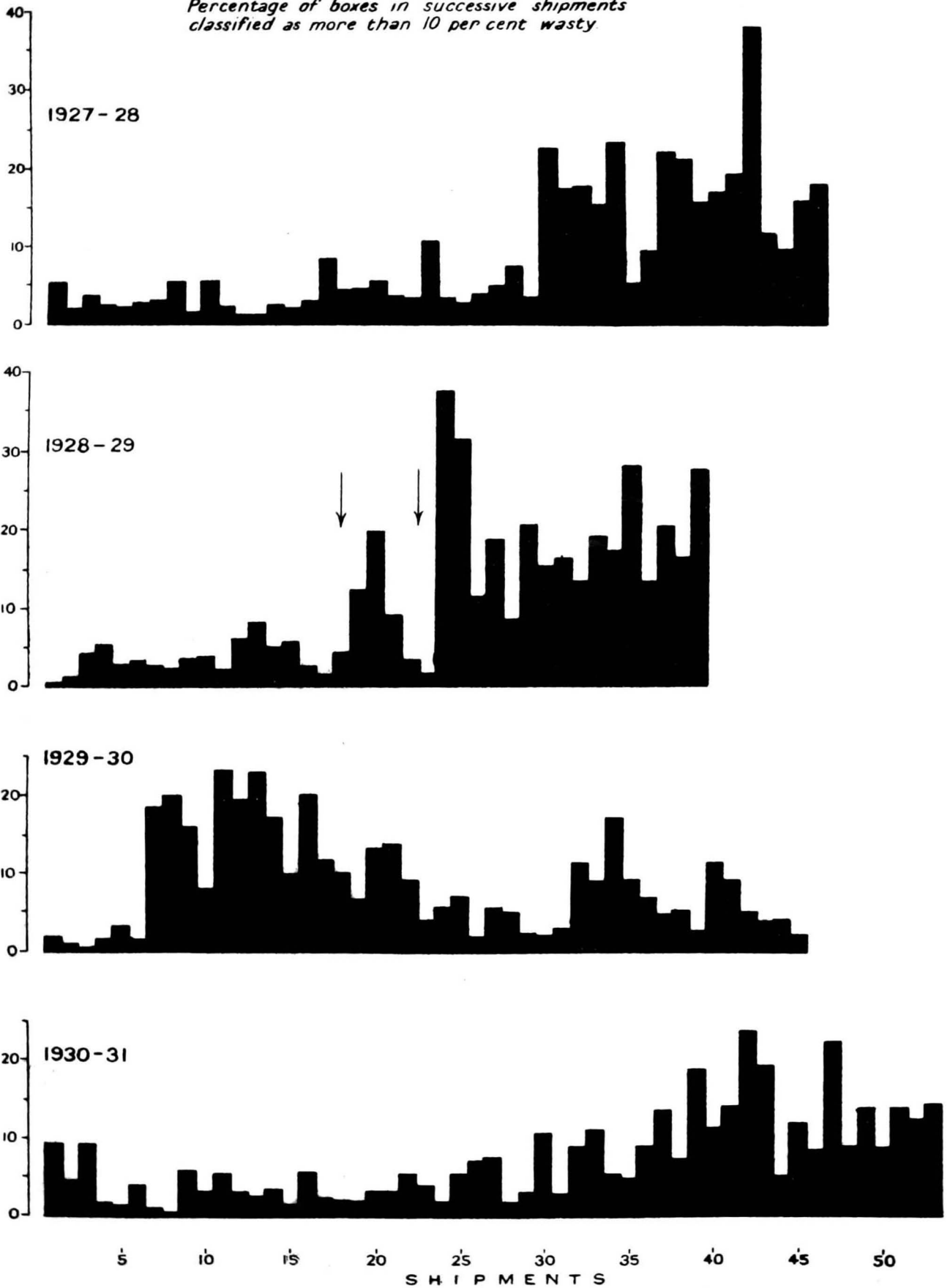


TABLE II.—*Wastage in Individual Marks*

Mark.				Wastage (per cent.) in Shipment.				
				1	2	3	4	5
A	..	..	..	—	3	7	—	2
B	..	..	..	3	4	15	5	6
C	..	..	..	3	3	14	—	—
D	..	..	..	4	3	7	4	4
E	..	..	..	3	—	10	5	9

In this case, shipments 3 and 4 were loaded and sailed on the same day ; it is thus probable that the consignments in each vessel were comparable at the time of loading and that the appreciably greater wastage in shipment 3 on arrival was due to less favourable shipping conditions. In other cases it may be, however, that pre-shipment factors influencing a large proportion of the cargo might have a similar effect.

The incidence of wastage among shipments in the 1928–29 season was studied somewhat closely to ascertain how far the variations could be attributed to definite causes and a brief summary of the fields explored is given below.

On two occasions during the season there were serious delays of more than a week in loading due to rough seas at the port of Jaffa ; these points are indicated by arrows, on the diagram in Figure XII. It is seen that in both cases the two shipments immediately following the delays arrived in very poor condition and showed a greater divergence from the normal wastage for the time of the season than any other shipments. Probably much of the fruit had been picked at the beginning of the period of bad weather and had to be held in storage under rather unfavourable conditions until loading was again possible. It may be also that the rainfall which occurred at the time increased the susceptibility of later picked fruit to wastage, although experiments designed to test this possibility did not give positive results (Section V).

The influence of certain other factors was tested by calculating by means of a moving average a smoothed curve for the normal wastage at different times of the season. The divergence from the normal curve in each shipment was then plotted against the length of the voyage, and in the case of those vessels for which fairly extensive

temperature data were available, against a roughly calculated value for the average temperature on arrival. In neither case was any correlation obtained, which suggests that neither the length of the voyage nor the temperature is independently a controlling factor in determining wastage. Some measure of correlation was secured by plotting the divergence from the normal wastage against a compound factor which took account both of temperature and length of voyage, but the agreement was not close. It is possible that the agreement would have been better if a more satisfactory value for temperature had been available, but it is more probable that there are other factors to be considered before any very definite correlation is to be obtained.

Variation in Wastage as between Different Marks

On unloading there is often a striking difference in the condition of fruit from different growers, more especially in the early part of the season when wastage is mainly due to *Diplodia* sp. This is not unexpected since the initial *Diplodia* infection normally takes place in the orchard, although the actual rot develops later during shipment.

These differences in wastage are widely recognised by members of the fruit trade, who normally speak of "good" and "bad" marks, thus implying some degree of consistency in the condition in which fruit from individual growers arrives. It was therefore thought of interest to undertake an analysis of the selection data to ascertain whether some marks did in fact consistently show more wastage, than the average, and what proportion of the total wastage in Jaffa oranges was due to the presence of these marks.

TABLE III.—*Number of Marks showing Various Percentages of Wastage*

Average Wastage throughout Season.	Number of Marks.	Proportion of Total Boxes (Per cent).	Proportion of Total Wastage (Per cent).
Over 20 per cent.	1	0.3	1.8
10-20 per cent	1	0.6	1.7
8-10 " "	4	3.3	6.6
6-8 " "	3	4.1	6.9
4-6 " "	24	54.7	59.1
2-4 " "	16	36.7	23.8
Under 2 per cent.	1	0.3	0.1
Total	50	100.0	100.0

Fifty marks were selected for this purpose, all of which were forwarded in fairly large and regular shipments throughout the season, and the average wastage in each was calculated for all shipments to Glasgow and Manchester during the 1928-29 season. The results are summarised in Table III which refers to a total of approximately 165,000 boxes.

It is seen that of the 50 marks, only two showed more than 10 per cent. of wastage ; these represented rather less than one per cent. of the total number of boxes analysed and contained only 3.5 per cent. of the total wastage. Similarly only 9 marks, representing 8.3 per cent. of the total boxes showed more than 6 per cent. of wastage. In the large majority of cases (40 marks representing 91.4 per cent. of boxes) the average wastage fell between 2 and 6 per cent., and thus did not differ greatly from the average for all oranges catalogued which in the 1928-29 season amounted to 5.6 per cent. (Appendix A).

On the whole it may perhaps be concluded that exceptionally wasty marks are comparatively rare and do not significantly affect the total wastage in Palestine orange shipments, and that the great majority of the marks in a cargo are fairly uniform in condition when unloaded. The variation in wastage as between different cargoes has already been discussed.

It should be noted, however, that the average wastage in the 50 marks specially analysed amounted to 4.7 per cent. as compared with 5.6 per cent. for all boxes catalogued during the season. (Appendix A.) Since the selected marks were those forwarded in large and regular consignments, this suggests that there is a tendency for the smaller marks to develop rather more wastage than the average.

It is also interesting to note that of the 50 marks, seven showed serious wastage in the early shipments : four of these seven fell into the group of nine marks which averaged more than 6 per cent. of wastage over the whole season. It would be anticipated that this early season wastage was due to *Diplodia* rotting and this fact was actually confirmed at the dock examinations. Sixteen of the 50 marks developed exceptionally heavy *Penicillium* wastage in the last six shipments, and seven of the sixteen were among the nine most wasty marks.

Wastage in Relation to Size

An analysis was made of the selection data for 16 shipments to Glasgow during the 1927-28 season to ascertain the incidence of wastage as between oranges of different sizes. For this purpose the

average wastage in the three counts, 120, 180 and 240 was calculated by the method described above; these are "American packs" containing large, medium and small oranges respectively of uniform size. A similar average was also calculated for the 144 Jaffa pack, which contains both large and medium sized oranges roughly corresponding to the 120 and 180 counts. The results of the analysis are summarised in Table IV and since each average is based on several thousand boxes it is believed that the data represent the relative condition of the three sizes with some accuracy.

TABLE IV.—*Size and Wastage*

Time of Season.	Average Wastage (per cent.) in Oranges of Count.			
	120 (Large).	180 (Medium).	240 (Small).	144 (Mixed Sizes).
Whole Season	4.4	4.9	5.9	3.7
First Four Shipments	2.3	2.5	2.9	1.9
Last Four Shipments	5.7	9.1	10.4	6.1

It is seen that over the whole season there was no pronounced difference as between the three sizes, but that on the whole wastage was greater in the smaller than in the larger oranges. This tendency was shown in every shipment taken individually. The 144 mixed pack, rather curiously, showed slightly less wastage than the large 120 oranges, instead of occupying an intermediate position as might have been anticipated.

Similar comparisons are shown for the first four shipments of the season, in which *Diplodia* rotting was the main form of wastage, and for the last four shipments in which *Penicillium* wastage was definitely the predominant type.

In the shipments in which wastage was due to *Diplodia* rotting it is seen that the incidence of wastage showed the same trend, but that the differences between the sizes are small. In the late shipments, on the other hand, the trend is much more pronounced. The average wastage in the small "240" oranges was nearly twice that in the largest size, while the mixed 144 count falls into place between the large and medium sizes. It thus appears that while there is little

difference in the susceptibility of large and small oranges to *Diplodia*, small oranges are definitely the more liable to *Penicillium* wastage. The latter type of wastage usually originates at bruises and other mechanical injuries and it is likely that the greater susceptibility of the smaller fruit is associated with their tendency to have thinner and, as a rule, more tender skins.

V.—INDIVIDUAL TYPES OF WASTAGE

In this section consideration is given to the factors influencing the development of the various types of wastage and to methods of control. It is to be noted, however, that the more serious fruit rots causing wastage are not peculiar to Palestine, but are common in most citrus areas where definite methods of control have in many cases been developed. Fundamental research to establish new methods of control is not therefore required, but much remains to be done in working out the most efficient methods by which the control measures already available may be applied under Palestine conditions. Valuable pioneer work in this direction is in progress at the Tel Aviv Experiment Station.

(i) *Blue and Green Moulds*

Rotting due to green and blue moulds occurs in oranges from all citrus producing areas of the world and, as already noted, is much the most serious cause of wastage in Palestine oranges. Green mould (*P. digitatum*) is the more important, but both rots, either separately or in association, are found in all shipments arriving from early January onwards. Both become more serious as the season advances and the fruit becomes more mature.

Infection by green mould almost invariably originates at some mechanical injury to the skin ; blue mould infection usually originates in the same way, though in favourable circumstances the fungus is also able to spread by contact. It is thus essential that oranges should be free from mechanical injury when shipped if wastage of this type is to be reduced to a minimum.* Experience in other countries has shown

* Additional control is also to be obtained by washing the fruits with disinfectant solutions such as borax or sodium carbonate before packing. Treatment with borax under a patented process is now generally employed in many packing houses in California and elsewhere. Experiments on these lines with successful results have recently been carried out at the Tel Aviv Experiment Station (8).

that such injuries are usually sustained during harvesting and packing, and there can be little doubt that insufficient care in handling and unsuitable methods of conducting these operations is largely responsible for the very heavy *Penicillium* wastage in Palestine oranges. It is not proposed to give a detailed list of precautions to be taken to avoid mechanical injury, for these a standard text book such as Fawcett's (6*) should be consulted, but mention may be made of some of the more important causes of injury under Palestine conditions.

Sharp pointed clippers, extremely liable to injure the fruit, are still employed in many groves rather than the round ended modern type. Scratches by finger nails are also a serious cause of injury, and it is important that the pickers' nails should be closely trimmed, or preferably that gloves should be worn during harvesting and other operations involving handling the fruit. Stems should always be cut flush with the button, since projecting stems are very liable to injure adjacent fruits ; this practice is, in fact, generally adopted in Palestine though instances have been observed where the stems had been left too long. Picking boxes or baskets should be adequately lined and quite free from any projections, splinters, twigs, grit or other foreign bodies liable to injure the fruit, while oranges should be placed in them carefully, not dropped. It should be emphasised that bruises and injuries so small as to pass unnoticed at the time of harvesting are sufficient to provide a point of entry for rotting fungi and are liable to lead to wastage during shipment. It is thus desirable that there should be careful supervision of picking and packing in order that any faulty work may be immediately detected and remedied.

Wilting.—A further source of injury lies in the common Palestine practice of piling oranges to a height of two to four feet in the packing sheds while awaiting packing. The pressure on the lower layers must invariably cause bruising, even if rush work or mats have been spread to protect the oranges from the floor ; any grit present will be pressed into the fruits, and any projecting stems will puncture adjacent oranges.

Further, air circulation within the mass of fruit will be negligible and practically no " wilting " of the interior fruit is therefore possible. As a result the skins of the oranges remain in a soft, turgid state instead of hardening and becoming less susceptible to mechanical injury as would be the case if the fruit were more freely exposed to

* See also the Decay of Citrus Fruits in Palestine and its Prevention, I. Reichert and F. Littauler, *Palestine Citograph (now Hadar)*, Vol 1, Nos. 8 and 9, 1928.

the air. Moreover, the warm, humid conditions in the interior of the pile provide very favourable conditions for fungal infection. Particular attention is paid to wilting in Australia where packing houses are provided with rows of shelves on which the fruit is spread to a depth of not more than two layers and left for a period varying three days to three weeks before packing. During this time the skin shrinks and toughens to a considerable extent.

It was thought of interest to test the influence of wilting on wastage in Palestine oranges, and a series of three experimental shipments was therefore undertaken to compare fruit packed immediately after picking with fruit wilted for periods of three, seven and ten days respectively. The fruit for the three shipments was picked under ordinary Palestine conditions without special supervision on 20th January, 14th February and 6th March, 1929, that is at a time when *Penicillium* wastage was general in all shipments. In each case four boxes were packed immediately on arrival at the packing house, the remainder of the fruit being left to wilt in open field boxes in a well-ventilated shed. This method of wilting was adopted as it necessitated no special facilities and could readily be followed by any grower without undue expenditure for shelving and storing space. At intervals of three, seven and ten days four further boxes were packed, all the fruit being of 150 or 180 count and the four successive packing groups comparable. On completion of packing the four groups were shipped to Liverpool, care being taken to ensure that in each case all boxes were stowed together in the same hold. The fruit was carefully examined immediately on arrival and re-examined after a further interval of four weeks.

The experimental method is open to criticism on the grounds that the first packed boxes were not shipped immediately after packing as would normally be the case, but this was unavoidable if all four sets were to be carried under the same shipping conditions. While awaiting shipment the packed boxes were stored under similar conditions to the wilting oranges.

The results of the three experiments are summarised in Table V, and it is seen that on the average the unwilted fruit showed between three and four times more *Penicillium* wastage than that wilted for seven or ten days. It thus appears that a considerable measure of control could be obtained by this means. Wilting for three days was rather less effective in reducing wastage.

TABLE V.—Average Wastage (per cent.) due to *Penicillium* Rotting in Wilted and Unwilted Oranges*

Time of Wilting (days).	First Shipment.	Second Shipment.	Third Shipment.	Combined Figures.
Not Wilted	5·8	8·0	8·2	7·3
3	1·5	4·9	2·0	2·8
7	1·7	2·5	2·0	2·1
10	1·5	1·0	3·0	1·8

In addition to *Penicillium* wastage, a certain amount of *Diplodia* rotting occurred in the third shipment. This injury was as serious in the wilted as in the unwilted fruit and it did not appear that any control had been effected by the treatment. At the second examination the increased wastage was mainly due to *Penicillium* rotting, but here again no marked difference was observed as between the wilted and unwilted fruit.

Influence of Rain.—There is a widespread belief in Palestine that oranges picked immediately after heavy rainfall are particularly liable to wastage and a number of experimental shipments were undertaken in 1929 to test this theory. It has already been noted (page 23) that in 1929 cargoes of oranges immediately following a temporary stoppage of shipments due to rain and rough seas at Jaffa showed considerably more wastage than the normal. It is likely, however, that much of the fruit in these cargoes was picked before

* It may also be of interest to show the results of the experiment classified according to the ordinary dock selection method. The combined figures for all three shipments were as follows :—

	Number of Boxes Classified as :—				
	I.	II.	III.	X.	Total.
Unwilted Fruit	2	4	4	2	12
Wilted 3 days	6	4	2	0	12
Wilted 7 days	8	4	0	0	12
Wilted 10 days	9	2	1	0	12

the onset of rainfall and that the heavy wastage largely resulted from the delay during which the fruit may have been stored under unfavourable conditions.

Four pickings were made from the same trees for these experiments, two immediately after heavy rainfall and two after a period of fine weather. The two lots harvested after rain and the two controls were picked alternately over the period from the middle of January to the end of May. In every case the fruit was packed three days after picking, while all shipments consisted of 12 boxes all of 150 or 180 counts. The results are shown in Table VI, and it is seen that both groups of shipments were in very similar condition on arrival in the United Kingdom. Wastage other than *Penicillium* rotting was in all cases negligible.

TABLE VI.—*Wastage due to Penicillium Rotting in Fruit Picked after Rain and Under Normal Conditions*

Fruit Picked after Rain.				Fruit Picked under Normal Conditions.			
			Wastage (Per cent.).				Wastage (Per cent.).
First Shipment	..	..	1·0	First Shipment	..	..	1·4
Second Shipment	..	..	3·3	Second Shipment	..	..	3·3

It is not claimed that these experiments are conclusive and further investigation under a wider range of conditions are necessary before the influence of rainfall on susceptibility to wastage can be definitely established. The results suggest, however, that this influence may be less than is generally supposed.

Influence of Type of Stock and Soil on Wastage.—Modern research has tended to emphasise the important influence of the root-stock, the type of soil and similar cultural factors on the susceptibility of fruit to wastage. As already noted, citrus soils in Palestine range from a light sand to a heavy loam, while two types of stock, the sour orange and the sweet lime, are in general use.

Accordingly it was thought of interest to include four equal quantities of comparable oranges grown on each type of stock from both light and heavy soils in certain of the experimental shipments. The fruit from these shipments was picked from a grove in which both light and heavy soil occurred. This system was followed both to obtain a sample representative of all types of oranges shipped, and

to secure preliminary data on the comparative carrying quality of the various types of fruit. Definite results could of course only be obtained in an extended investigation continuing over several seasons.

In the present case, 10 shipments totalling 128 boxes were made and the percentage of *Penicillium* rotting in the four groups over the whole season was as follows :—

Sour orange stock, heavy soil	.. ..	1·3 per cent.
Sour orange stock, light soil	.. ..	2·4 per cent.
Sweet lime stock, heavy soil	.. ..	3·0 per cent.
Sweet lime stock, light soil	.. ..	3·3 per cent.

The rate of post-shipment wastage followed the same order, being least in the sour orange stock, heavy soil fruit and greatest in that grown on sweet lime stock and light soil. On the average the latter deteriorated rather more than twice as rapidly as the first type.

Between 30 and 40 per cent. of the wastage on arrival was due to *P. italicum* in the oranges on sweet lime stock, compared with about 10 per cent. in the oranges on sour orange stock; the remainder were rotted by *P. digitatum* alone, or by both fungi. This difference was not shown in the further deterioration after unloading, when about 35 per cent. of the wastage in all four groups resulted from *P. italicum* rotting.

The above results suggest that fruit grown on sour orange stocks is somewhat more resistant to *Penicillium* wastage than fruit on sweet lime stock, and that fruit from heavy soils is rather more resistant than that from light soils. In view of the limited scale of the experiment and of the fact that all the fruit came from one grove, it is not claimed that the above result is significant, but it suggests that similar investigations on a larger scale might usefully be undertaken in Palestine.

Development of Penicillium Rotting after Unloading.—Investigations by the Empire Marketing Board (4) and the Food Investigation Board (1) have shown that the wastage found in imported fruit on unloading by no means represents the total loss, but that there is often considerable further deterioration before the fruit reaches the consumer. This post-shipment wastage is partly associated with the considerable interval sometimes occupied in marketing the fruit after its arrival. Thus in one case investigated, the average time which elapsed after unloading before certain varieties of New Zealand apples reached the retail shop varied from 10 days to 3 weeks, and in one variety 20 per cent. of the boxes did not reach the retailer

until five weeks or more after unloading. It is not suggested that this example is representative of what normally occurs, but it is sufficient to demonstrate the importance of landing fruit in such condition that it can be held for an appreciable time without undue deterioration.

A number of samples of oranges were therefore held under observation for periods ranging up to five weeks after unloading to gain some idea of the rate of development of wastage. In all cases the fruit was stored in a cool warehouse at atmospheric temperature, under conditions very similar to those obtained under commercial conditions. Most of the oranges were of 150 or 180 counts, but some groups consisted of 144 and 240 counts. All wasty fruits were removed at each examination.

TABLE VII.—*Development of Penicillium Rotting after Unloading*

No. of Sample.	Date of First Examination.	Number of Boxes in Sample.	Percentage of Penicillium Rotting.				
			on Arrival.	Second Week.	Third Week.	Fourth Week.	Fifth Week.
1	December 12 ..	12	Nil.	—	0·2	—	—
2	January 1 ..	4	5·5	—	7·4	—	—
3	January 17 ..	20	3·0	—	3·7	—	4·4
4	January 30 ..	8	0·2	0·5	—	1·2	—
5	February 8 ..	8	2·3	2·7	—	—	—
6	February 13 ..	12	0·9	—	1·5	—	—
7	February 28 ..	8	0·4	1·2	—	—	—
8	February 28 ..	4	9·0	12·2	—	—	—
9	March 5 ..	16	2·5	3·5	—	—	5·7
10	March 7 ..	8	3·3	5·4	—	9·4	—
11	March 7 ..	4	13·7	—	19·8	—	33·0
12	March 8 ..	4	4·9	7·3	12·7	—	—
13	March 14 ..	12	3·4	—	5·4	—	8·1
14	March 22 ..	16	4·4	6·8	—	9·7	—
15	March 26 ..	8	1·4	—	2·3	—	3·4
16	April 9 ..	16	3·4	—	5·6	—	8·4

The development of Penicillium rotting in these samples is summarised in Table VII ; this constituted the main type of wastage. The figures for the later examinations represent the total development of wastage to that date and are inclusive of the earlier figures. Some

boxes also contained a certain number of Diplodia rots on arrival, but in general these did not develop further (Table X). There was, however, an appreciable development of "stale spot" in storage (page 21). The dates of the first examination are included to give a rough indication of the maturity of each sample of fruit, but the data included refer to oranges stored in more than one season.

It is seen that in general the development of wastage was not unduly rapid, with the exception of sample 11. This consisted of small oranges (count 240) with very fine, tender skins and the post-shipment wastage was largely due to *P. italicum*.

It is to be remembered, however, that the fruit was handled with more care than would be possible in rapid work of selection at the docks. Further, the boxes were left undisturbed in the warehouse, while in commercial consignments there is the added factor of transport which may well have a considerable effect when fruit is re-packed loosely.

To test the influence of the method of selection, eight comparable boxes of 144 count were taken. Four were submitted to selection at the dock in the ordinary way, while the remaining four were carefully examined by the Board's officers. The boxes were then held under observation and re-examined after 10 and 20 days' storage. The results are summarised in Table VIII and it is seen that at both examinations there was nearly twice as much wastage in the fruit selected by fruit hands at the dock as in the carefully selected fruit. Wastage in all cases was due to *Penicillium* rotting. It thus appears that the process of selection may have an appreciable effect on post-shipment deterioration.

TABLE VIII.—*Development of Wastage in Ordinarily and Carefully Selected Oranges*

Sample.	Wastage (per cent.).	
	10 days.	20 days.
Fruit Selected at Docks	3.2	10.0
Carefully Selected Fruit	1.7	5.5

A similar experiment was undertaken in co-operation with the Food Investigation Board to test the effect of transport on boxes re-packed in a slack condition. Oranges from four boxes of 144 count

were thoroughly mixed and then re-packed to make the boxes strictly comparable. From two of these boxes 4 per cent. of the oranges were removed to produce a degree of slackness corresponding to a box classified in Grade II at the dock selection. All four boxes were then railed from Liverpool to Cambridge where they were re-examined at weekly intervals at the Cambridge Low Temperature Research Station. It is seen (Table IX) that on arrival at Cambridge both groups were in similar condition, but the effect of the greater bruising in the slack boxes rapidly became apparent in storage. The experiment illustrates very clearly the advantage of re-packing boxes as sound before transportation.

TABLE IX.—*Development of Penicillium Rotting in Tight and Slack Boxes of Oranges*

Days after Arrival.	Wastage (per cent.).	
	"Slack" Boxes.	"Tight" Boxes.
0	0.0	0.4
7	3.0	1.4
13	12.0	5.7
20	23.3	11.0

To summarise, it appears that under favourable conditions post-shipment wastage of Palestine oranges is in most instances not unduly rapid. Selection at the docks and the handling of slack boxes may, however, very seriously increase the liability to wastage, and since these procedures are very frequently involved in commercial shipments it is important that the fruit should be moved into consumption as quickly as possible after unloading.

(ii) *Diplodia Rotting (Water-logging, black-ball waste)*

Rotting by the fungus *Diplodia sp.* is nearly as widespread as ordinary green mould wastage and has been reported from most countries where oranges are grown commercially. The injury is primarily a disease of the grove and in consequence varies widely in its incidence as between different "marks." The spores of the fungus are harboured in dead wood, twigs, and bark, and are blown or washed on to the fruit, which is usually invaded at the point of attachment of the stem. Careful handling is therefore ineffective in controlling the injury, but its incidence may be greatly reduced by

pruning away and burning all dead twigs and other tissue likely to harbour spores, and by spraying. Recent investigations at the Tel Aviv Experiment Station have demonstrated in a striking manner the effectiveness of this treatment under Palestine conditions.

Information on the association of *Diplodia* wastage with grove conditions was collected during the 1927-28 and 1928-29 seasons, when cables were sent to the Board's officers stationed at Jaffa advising them of those marks which showed serious stem end rotting on arrival.

The groves from which this fruit had originated were traced and a considerable number visited. In nearly all instances it was found that these groves were old, more or less neglected, and in a condition favourable to *Diplodia*. Many of the trees were affected with gummosis, and showed an abundance of dead wood, twigs and bark, while the branches were often encrusted with lichens. There can be little doubt, therefore, that stem end rotting in Palestine oranges could be very greatly reduced by improved sanitary measures in the groves.

Temperature Relations of Diplodia.—The temperature relations of *Diplodia* are of particular interest in connection with wastage. Like all fungi, its growth rate increases with rise in temperature until a certain optimum value is reached. *Diplodia* is distinctive, however, in that growth is greatly retarded at temperatures below 55° F. and practically ceases at a slightly lower temperature (10). Penicillium, on the other hand, continues to develop at temperatures below 40° F.

This characteristic is the most probable explanation of the seasonal incidence of *Diplodia* wastage in Palestine oranges. The disease is serious in the early shipments, falls off considerably during the main part of the season, but increases somewhat in the final consignments arriving towards the end of March. The periods of significant wastage thus correspond with periods of fairly high atmospheric temperature in the grove which are probably necessary for the development of the disease. It is to be noted, however, that the temperatures in orange holds are normally high enough for fairly rapid growth, even in the mid-season period; the failure of the disease to develop at that time is perhaps due to an insufficiently long period of incubation since low temperatures again prevail after unloading.

The inhibition of the growth of *Diplodia* at low temperatures also accounts for the comparatively slight post-shipment development of this type of wastage, since the fruit is marketed during the season of cold weather. This slow rate of development is illustrated by the

data in the following table, which shows the percentage of *Diplodia* rotting in oranges held under observation and examined from time to time (page 33). It is seen that although in many cases there was an appreciable amount of this type of wastage on arrival, very little increase was found at the later examinations. Samples 13 and 16 represent partial exceptions, and in both these cases atmospheric temperatures were above the normal. That the conditions generally were not unfavourable to all fungal growth is shown by the fact that at the same time there was a material development of *Penicillium* rotting (Table VII).

TABLE X.—*Development of Diplodia Rotting after Unloading*

No.	Date of First Examination.	Number of Boxes in Sample.	Percentage of <i>Diplodia</i> Rotting.				
			on Arrival.	Second Week.	Third Week.	Fourth Week.	Fifth Week.
1	December 12 ..	12	12.5	—	12.5	—	—
2	January 1 ..	4	Nil.	—	Nil.	—	—
3	January 17 ..	20	2.1	—	2.1	—	2.2
4	January 30 ..	8	0.3	0.3	—	0.3	—
5	February 8 ..	8	Nil.	Nil.	—	—	—
6	February 13 ..	12	0.2	—	0.2	—	—
7	February 23 ..	8	Nil.	Nil.	—	—	—
8	February 28 ..	4	Nil.	Nil.	—	—	—
9	March 5 ..	16	0.3	—	—	—	0.3
10	March 7 ..	8	0.3	0.3	—	0.3	—
11	March 7 ..	4	Nil.	—	Nil.	—	Nil.
12	March 8 ..	4	Nil.	Nil.	Nil.	—	—
13	March 14 ..	12	1.8	—	2.0	—	2.4
14	March 22 ..	16	1.7	1.7	—	1.8	—
15	March 26 ..	8	0.1	—	0.1	—	0.2
16	April 9 ..	16	1.9	—	2.1	—	2.6

Treatment with Ethylene.—In recent years, considerable attention has been paid to the artificial colouring of oranges by storing them in an atmosphere containing a trace of ethylene; concentrations of 1 part in 1,000 to 1 in 10,000 being usually employed. This treatment hastens the ripening process to such an extent that pale yellow oranges develop a satisfactory colour after a few days' exposure at a fairly high temperature. Experience in America showed, however, that oranges

treated in this way become particularly susceptible to *Diplodia* infection. On further investigation (10) it was found that this difficulty could be overcome if the "buttons" (the portion of the stem still adhering to the fruit) were removed before packing, when the susceptibility of the fruit was actually decreased. The operation thus constituted a method of controlling *Diplodia* rotting. Ethylene treatment normally loosens the buttons so that they may be removed without difficulty.

Colouring early season Palestine oranges with ethylene was first attempted in the 1927-28 season when several treated consignments were forwarded by private shippers. All of these were examined on arrival and were found to have coloured satisfactorily, but in nearly every case showed severe stem end rotting. Since comparable untreated fruit was not included in these consignments, it was not certain that this wastage had resulted from exposure to ethylene.

Accordingly a series of four experimental shipments were undertaken during the following season to ascertain definitely if artificial colouring did seriously increase *Diplodia* decay of Palestine oranges, and whether satisfactory control could be obtained by "dis-buttoning" the fruit. The results showed clearly that susceptibility to rotting was increased, but no satisfactory "dis-buttoning" experiments were possible as difficulty was found in loosening the buttons sufficiently to remove them without injuring the fruit. In one experiment, for example, 24 comparable boxes of fruit of counts 180 and 150 were prepared, 8 were set aside as controls and the remainder treated with ethylene for five days at about 60°-68° F. Eight of the 16 treated boxes were then packed for shipment and set aside with the controls. An attempt was made to dis-button the fruit in the remaining eight boxes. As this proved impossible further ethylene treatment was given for two days at 68°-78° F.; but the buttons still showed no sign of loosening. It was considered unwise to attempt further treatment; all 24 boxes were therefore shipped together to Liverpool. Wastage on arrival was as follows:—

TABLE XI.—*Influence of Ethylene Treatment on Wastage*

Sample.	<i>Diplodia</i> rotting (per cent.).	<i>Penicillium</i> rotting (per cent.).
Control (Untreated) ..	0·2	1·0
Treated Once	3·1	4·0
Treated Twice	4·0	6·0

The above experiment may be taken as typical of the results obtained. It is seen that in this case there was an increase in *Penicillium* as well as in *Diplodia* rotting, and this was also found in other consignments, although the effect was less pronounced. No effective method of dis-buttoning was discovered although experiments were made with various gas concentrations, temperatures, humidities and times of exposure.

These observations have since been extended at the Tel Aviv Experiment Station and a satisfactory method of loosening the buttons was developed.* The development of *Diplodia* rotting in oranges treated with ethylene and afterwards dis-buttoned was compared with untreated controls and with oranges dis-buttoned by force without ethylene treatment. It was found that dis-buttoning by either method reduced the incidence of *Diplodia* rotting as compared with untreated fruit, but that dis-buttoning by force greatly increased the susceptibility of the fruit to *Penicillium* moulds, even though the wound was shellacked before storage. It was considered, however, that it was advisable to employ ethylene colouring only with fruit from carefully tended groves which were fairly free from *Diplodia* infection.

TABLE XII.—*Sugar-Acid Ratios of Palestine Oranges at Various Stages of Season*

Time of Season.	Number of Samples Tested.	Range.	Average.
Mid-December	20	5.5–7.5	6.5 : 1
Mid-January	15	7.4–9.1	8.0 : 1
Late February	25	8.1–12.8	9.8 : 1
Mid-March	10	10.8–12.7	11.8 : 1

It should be noted that there is considerable justification for artificially coloured Palestine oranges, since the fruit frequently attains a satisfactory degree of sweetness while still pale yellow and unripe in appearance. For example, the sugar-acid ratios of 20 samples of artificially coloured and pale, untreated oranges taken in mid-December ranged from 5.5 to 7.5 and averaged 6.5.† This does

* Confidential report to the Empire Marketing Board.

† These ratios were determined by the standard method (11) and represent the ratio of soluble solids, measured by the Brix Hydrometer, to acid estimated by titration with N/10 caustic soda solution and calculated as citric acid.

not compare unfavourably with the South African minimum standards of 5.5 for Seedlings, 6.0 for Valencias and 6.5 for Navels, and approaches the Californian minimum ratio of 8:1. Later in the season considerably higher ratios are attained as shown by Table XII.

Artificial colouring involves an element of risk, however, as the shipment of any well-coloured and apparently ripe fruit which had not in fact attained a satisfactory degree of sweetness would undoubtedly harm the market reputation of Jaffa oranges. If the process is ever widely adopted, it would appear necessary to fix a minimum sugar-acid ratio for export fruit and to initiate a system of testing consignments before export similar to those already in force in South Africa and California.

(iii) *Alternaria Rotting*

Alternaria decay of oranges occurs in most citrus areas. It is not as a rule a serious source of wastage, but has occasionally caused appreciable losses in Navel oranges. Reichert (7) states that the disease has been encountered on several occasions in Palestine groves, though not to any considerable extent, and describes it as follows:—

“The fruit is attacked by this disease which appears in the form of a black rot on the blossom end and the rot proceeds to the core of the fruit. The causal organism penetrates to the fruit through the styler end. Fruits infected with this disease ripen earlier than sound fruits.”

Alternaria rot was observed on several occasions in Palestine oranges shipped to the United Kingdom market during the 1928–29 season, mainly in fruit which had been kept under observation for some time after unloading. The decay assumed several different forms, which may be briefly described.

In most instances the affected fruits appeared sound externally, but on cutting, the core was found to be soft and watery with a pink or pinkish brown discoloration in some cases shading to black. *Alternaria* was isolated from the diseased cores. In one consignment core-rots of this type were associated with a reddish brown discoloration of the skin, centering round the styler end. Apparently sound oranges from this consignment were kept in a warm room for a few weeks, when the majority developed both skin discoloration and core-rots. In all cases *Alternaria* was isolated in culture.

More infrequently dry, black *Alternaria* core rots of the type described by Reichert and other workers were observed, and in a few instances black rotted areas were found in the albedo and in the pulp.

It is interesting to note that only the latter type of core rot appears to have been described previously as occurring in oranges and no mention has been found of the pinkish core rot which is apparently the more common form in Palestine oranges. The latter, however, very closely resembles an *Alternaria* rot of lemons (5) which is also sometimes associated with a brown discoloration of the rind at the stem or stylar end. This disease is stated to be serious only in lemons which are physiologically weak, and the control measures suggested are indirect and designed to produce sound, healthy fruit, rather than spraying or other direct methods. In this connection it will be recalled that the core rot of Palestine oranges occurred mainly in fruit which had been stored for a considerable time and which was therefore likely to be in physiologically weak state.

As regards the dry, black form of decay, here again no direct measures appear to give effective control. Spraying with lime, sulphur or Bordeaux mixture gave negative results in trials undertaken in California.

As *Alternaria* rotting could only be detected on cutting, it is impossible to estimate its extent; in one instance, when a large number of fruits were cut, about 3 per cent. were found to be affected. On the whole it is doubtful if the injury is often extensive, but from the above observations it appears possible that the decay may become more serious in fruits which for any reason do not come into consumption for a month or so after unloading, particularly towards the end of the season.

VI.—SUMMARY

1. Almost the whole of the export consists of one variety, the "Shamouti" or "Jaffa" orange. Increasing quantities of poor quality strains have been shipped during recent years and it appears desirable that such oranges should as far as possible be eliminated from export consignments.

2. The temperature of the fruit at the time of shipment is usually between 62° and 68° F. Readings as high as 70° F. and as low as 53° F. have been recorded.

3. On arrival wide temperature variations are found and differences of 20° F. are not unusual in a cargo. The highest and lowest temperatures normally occurring are 72°-73° F. and 44°-48° F., respectively. Temperatures well below 40° F. have been noted in very cold weather. A range of 50° to 65° F. may be taken as a

general average, but differences between individual shipments on arrival are very considerable. The temperature of the bulk of the cargo thus tends to fall slowly during the voyage and at the time of arrival is usually 5° to 10° F. lower than at the time of loading. The cooling action of the sides of the ship appears to be the most important agency in reducing the temperature.

4. There is a certain measure of regularity in the temperature distribution throughout the holds. At the extreme ends of the vessel fore and aft, temperatures are usually below 50° F. The temperature tends to rise towards the middle of the vessel and near the engine room bulkheads temperatures approaching 70° F. were recorded. A certain amount of heating is caused by the engine room bulkheads and it is suggested that these should be insulated.

5. The upper part of the cargo is warmer than the lower. In a stack of six or eight tiers a difference of 3° to 4° F. is usual between top and bottom. The top layer, however, is slightly cooler than the layer immediately beneath, owing to surface cooling. In general, there is little difference in temperature between the 'tween deck cargo and that in the lower holds.

6. Over the whole season wastage is approximately 5 per cent. On the basis of the priced auction catalogues the financial loss resulting from wastage during the 1928-9 season was estimated at approximately £135,000.

7. About 90 per cent. of the wastage appears to be due to the storage rotting caused by *Penicillium digitatum* and *Penicillium italicum*. The next most serious type of wastage is a stem end rot caused by *Diplodia Natalensis*. This decay is most common at the beginning of the season and is rarely serious in shipments arriving after Christmas. The seasonal incidence of *Diplodia* rotting is probably accounted for by the temperature relations of the fungus. The methods available for controlling these types of wastage are discussed.

8. Wastage increases as the season advances. This reflects the increased susceptibility to *Penicillium* rotting as fruit ripens. There is also a considerable difference as between individual shipments, apart from the seasonal increase.

9. An analysis was made of the comparative wastage in different marks. Some marks were found to develop considerably more wastage than the average, particularly at the beginning of the

season. But on the whole it was concluded that most of the marks in a cargo are fairly uniform in condition on unloading and that exceptionally wasty marks comparatively rare and do not significantly affect the total wastage. There is a tendency for the smaller marks to develop rather more wastage than the average. There appears to be no marked relation between size of fruit and susceptibility to wastage, but on the whole, smaller fruit is rather more susceptible to *Penicillium* rotting.

10. Experiments were undertaken to test the influence of wilting on *Penicillium* wastage. Wilting for 7 to 10 days reduced wastage to a considerable extent.

11. No difference in wastage was observed in experimental oranges picked from the same trees before and after rainfall.

12. All experimental shipments included fruit grown on sour orange and sweet lime stocks and on heavy and light soils. In all cases the fruit from sour orange stocks and heavy soil proved the most resistant to wastage.

13. Fruit coloured with ethylene gas was found to be more susceptible to *Diplodia* rotting than untreated fruit. Dis-buttoning of treated fruit reduced the incidence of *Diplodia* rotting.

14. Early season fruit, though pale in colour, gave fairly satisfactory sugar acid ratios. As the season advances the ratio rises considerably. If artificial colouring with ethylene is widely adopted, however, there is some danger of unripe fruit being shipped and in that event it is suggested that a minimum sugar acid ratio should be fixed for export fruit.

15. *Alternaria* has been observed occasionally in Palestine oranges shipped to the United Kingdom. The rot occurred mainly in fruit which had been stored for some time. It is doubtful if this injury is often extensive, but it is possible that the decay may become more serious in fruits which do not come into consumption for a month or so after unloading.

16. Under favourable conditions post-shipment wastage of Palestine oranges is in most instances not unduly rapid. Selection at the docks and the handling of slack boxes may, however, seriously increase the liability to wastage. Since these procedures are usually involved in commercial practice, it is important that the fruit should be moved into consumption as quickly as possible after unloading.

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APPENDIX A
CLASSIFICATION AND AVERAGE PERCENTAGE WASTAGE IN
PALESTINE ORANGE SHIPMENTS, 1927-28

Ship- ment.	Date of Sailing.	Length of Voy- age.	No. Cases in Cargo.	Per- centage of Cargo Cata- logued.	No. of Cases Classified as					
					I.	II.	III.	X.	XX.	Wasty.
1	—	—	23,594	57	11,932	367	339	358	379	0
2	—	—	20,100	53	9,442	750	310	149	62	0
3	—	—	35,500	59	16,277	2,915	861	607	170	0
4	—	—	26,000	63	14,011	1,313	653	304	88	0
5	—	—	24,000	94	20,218	888	833	436	32	0
6	5.12	15	15,971	80	11,104	527	725	321	25	0
7	13.12	18	22,095	77	13,054	1,821	1,802	342	146	0
8	15.12	23	22,700	71	9,766	3,608	1,809	763	104	0
9	19.12	17	22,900	62	12,449	1,224	305	160	80	0
10	26.12	15	28,800	76	12,973	5,280	2,424	1,051	215	0
11	28.12	15	27,775	63	12,329	2,634	2,089	330	247	0
12	31.12	17	17,200	70	8,402	2,662	804	135	23	0
13	31.12	18	28,600	73	18,132	1,509	938	96	125	0
14	4.1	16	24,980	69	12,663	3,314	872	329	83	0
15	5.1	17	24,600	76	12,308	4,589	1,482	341	33	0
16	7.1	16	27,300	71	12,737	4,308	1,432	437	117	0
17	12.1	23	27,500	60	4,975	7,397	2,704	1,146	201	0
18	16.1	18	27,000	77	12,093	5,171	2,632	704	160	0
19	19.1	18	28,000	80	10,457	7,579	3,400	822	119	0
20	21.1	17	28,600	73	7,560	9,410	2,898	988	152	0
21	21.1	17	27,000	74	12,222	4,847	2,165	576	131	0
22	28.1	16	34,200	74	14,540	6,968	3,046	660	191	0
23	28.1	19	26,900	59	7,307	4,187	2,710	1,286	388	0
24	30.1	17	30,624	81	12,599	8,092	3,424	702	75	0
25	2.2	20	23,524	72	10,301	4,418	1,695	296	119	0
26	2.2	19	39,800	59	7,510	11,201	3,654	815	102	0
27	11.2	18	22,000	76	7,512	5,594	2,866	772	66	0
28	12.2	16	34,487	65	8,532	6,953	5,103	1,392	271	0
29	18.2	16	28,900	82	11,995	7,779	3,014	603	155	0
30	1.3	19	22,042	68	1,197	6,883	3,679	2,293	1,068	0
31	1.3	15	32,800	87	7,878	8,539	7,211	3,994	926	0
32	4.3	17	32,410	68	4,609	6,771	6,867	3,060	827	0
33	8.3	19	27,000	85	5,983	7,930	6,096	2,851	607	0
34	12.3	21	29,474	82	732	10,834	7,012	4,532	1,070	0
35	12.3	20	30,500	72	10,476	6,949	3,546	996	149	0
36	15.3	21	27,358	84	8,108	7,728	5,070	1,700	413	0
37	15.3	22	25,440	86	3,721	6,874	6,631	3,660	1,071	134
38	21.3	14	27,032	92	6,140	7,107	6,501	4,012	1,223	0
39	24.3	19	23,050	91	5,108	6,706	5,820	2,689	476	71
40	25.3	20	23,600	74	1,337	8,726	4,594	2,190	695	0
41	28.3	17	21,700	82	4,569	5,324	4,650	2,537	709	117
42	1.4	21	19,329	67	360	4,373	3,321	3,053	1,529	291
43	2.4	17	30,150	87	10,001	8,377	4,862	2,307	682	10
44	7.4	20	24,000	50	5,382	3,552	2,061	787	339	0
45	9.4	18	13,948	86	4,200	3,452	2,488	1,387	488	9
46	9.4	16	15,510	75	1,052	4,582	3,825	1,799	390	28
Total	..	—	1,195,991	73	416,303	241,423	141,523	60,768	16,721	660

APPENDIX A—continued

Shipment.	Percentage of Cases Catalogued as						Estimated Wastage (Per cent.).
	I.	II.	III.	X.	XX.	Wasty	
1	89.3	2.7	2.5	2.7	2.8	0.0	2.7
2	87.9	7.0	2.9	1.4	0.6	0.0	1.8
3	77.9	14.0	4.2	3.0	0.8	0.0	2.4
4	85.6	8.0	4.0	1.9	0.5	0.0	2.0
5	90.25	3.96	3.71	1.94	0.0	0.0	1.7
6	87.5	4.1	5.7	2.5	0.2	0.0	2.0
7	76.0	10.6	10.5	2.0	0.9	0.0	2.6
8	60.8	22.4	11.5	4.7	0.6	0.0	3.3
9	87.5	8.6	2.15	1.15	0.6	0.0	1.7
10	59.1	24.1	11.1	4.6	1.0	0.0	3.5
11	70.0	14.9	11.85	1.85	1.4	0.0	3.9
12	70.0	22.10	6.6	1.1	0.2	0.0	2.2
13	87.2	7.2	4.5	0.5	0.6	0.0	1.8
14	73.4	19.3	5.0	1.9	0.5	0.0	2.2
15	65.7	24.4	7.9	1.8	0.2	0.0	2.5
16	65.9	22.3	9.0	2.2	0.6	0.0	2.7
17	30.3	45.0	16.5	6.95	1.2	0.0	4.8
18	58.3	25.0	12.6	3.4	0.8	0.0	3.3
19	46.7	33.9	15.2	3.7	0.5	0.0	3.6
20	36.0	44.8	13.8	4.7	0.7	0.0	4.0
21	61.3	24.25	10.85	2.9	0.7	0.0	3.0
22	57.2	27.4	12.0	2.6	0.8	0.0	3.2
23	46.1	26.3	17.1	8.1	2.4	0.0	5.0
24	50.5	32.5	13.75	2.85	0.3	0.0	3.3
25	61.2	26.2	10.05	1.75	0.7	0.0	2.9
26	32.2	48.2	15.7	3.5	0.4	0.0	4.0
27	44.7	33.2	17.1	4.6	0.4	0.0	3.8
28	38.3	31.3	23.0	6.2	1.2	0.0	4.7
29	50.8	33.0	12.8	2.6	0.7	0.0	3.4
30	8.0	45.3	24.4	15.2	7.1	0.0	8.8
31	27.6	29.9	25.3	14.0	3.2	0.0	6.9
32	20.8	30.6	31.0	13.8	3.7	0.0	7.5
33	26.1	32.2	26.6	12.4	2.7	0.0	6.5
34	3.2	44.7	29.0	18.7	4.4	0.0	8.7
35	47.3	31.4	16.0	4.5	0.7	0.0	3.8
36	35.2	33.5	22.0	7.4	1.8	0.0	5.2
37	16.9	31.1	30.0	16.6	4.8	0.6	8.7
38	24.6	29.4	26.1	16.0	4.9	0.0	7.8
39	24.5	32.1	27.8	12.9	2.3	0.3	6.8
40	7.6	49.7	26.2	12.5	4.0	0.0	7.4
41	25.5	29.7	25.9	14.1	4.0	0.7	7.7
42	2.8	33.8	25.6	23.6	11.8	2.3	13.4
43	38.1	31.9	18.5	8.8	2.6	0.05	5.4
44	44.4	29.3	17.0	6.5	2.8	0.0	4.9
45	34.9	28.7	20.7	11.5	4.1	0.1	6.5
46	9.0	39.3	32.8	15.4	3.3	0.2	8.1
Total..	47.5	27.5	16.1	6.9	1.9	0.1	4.6

APPENDIX B
CLASSIFICATION AND AVERAGE PERCENTAGE WASTAGE IN
PALESTINE ORANGE SHIPMENTS, 1928-29

Ship- ment.	Date of Sailing.	Length of Voy- age.	No. of Cases in Cargo.	Per- centage of Cargo Cata- logued.	Number of Cases Classified as					
					I.	II.	III.	X.	XX.	Wasty
1	3.11	16	25,719	50	12,909	14	6	6	8	0
2	6.11	15	28,458	56	14,037	1,151	719	138	48	0
3	13.11	19	21,220	81	14,373	1,122	924	577	117	4
4	15.11	18	17,324	65	7,548	1,778	1,254	474	135	4
5	25.11	—	20,445	48	7,836	1,057	734	187	48	0
6	27.11	15	25,650	79	16,817	1,485	1,225	329	331	0
7	3.12	16	22,200	14	2,232	637	88	34	38	0
8	4.12	16	24,204	69	14,380	1,105	750	284	65	0
9	15.12	18	26,345	80	14,644	3,723	1,812	615	152	0
10	18.12	15	23,900	58	4,254	6,786	2,479	495	35	0
11	20.12	18	27,690	63	13,056	3,230	957	280	67	0
12	23.12	22	22,500	66	6,382	5,032	2,564	790	86	0
13	25.12	16	28,100	76	11,715	4,962	2,953	1,368	351	0
14	27.12	17	11,000	40	1,762	1,590	794	190	22	0
15	30.12	17	26,862	73	7,942	8,402	2,179	841	237	25
16	1.1	16	26,565	80	13,597	4,382	1,652	323	119	1
17	4.1	—	25,200	22	2,628	2,005	719	82	5	0
18	7.1	16	20,589	71	6,914	5,763	1,249	504	91	0
19	17.1	14	26,100	71	6,152	6,169	3,870	1,787	441	2
20	19.1	23	23,800	78	5,487	4,937	4,447	2,661	894	40
21	26.1	16	25,800	72	3,453	9,589	3,981	1,301	306	34
22	28.1	14	28,200	79	14,095	5,332	2,100	662	111	0
23	30.1	17	26,500	64	5,520	8,127	3,073	253	10	0
24	8.2	24	30,000	72	3,044	4,297	6,131	5,832	2,104	156
25	11.2	19	26,500	75	3,658	4,762	5,259	3,869	1,980	467
26	13.2	—	19,000	54	1,648	4,081	3,403	975	197	0
27	16.2	19	30,300	68	5,384	6,058	5,444	3,059	658	138
28	18.2	18	29,000	84	10,395	7,191	4,578	1,765	345	22
29	23.2	16	32,000	66	1,815	8,981	6,128	3,508	736	50
30	26.2	—	28,700	60	1,898	6,632	6,194	1,982	521	125
31	27.2	17	30,300	75	6,723	6,765	5,634	3,031	567	104
32	1.3	17	34,700	85	12,352	7,575	5,665	2,830	963	134
33	7.3	15	34,000	54	3,183	7,500	4,254	2,380	927	185
34	11.3	16	32,694	89	9,389	7,865	6,713	3,550	1,430	37
35	17.3	15	27,300	78	4,000	5,648	5,674	4,661	1,283	115
36	21.3	183	33,300	79	6,113	9,958	6,487	2,694	916	30
37	21.3	15	27,633	98	7,859	7,582	6,074	4,023	1,374	78
38	24.3	—	18,032	69	1,515	4,179	4,764	1,605	345	86
39	28.3	18	14,460	76	2,329	3,078	2,576	2,186	788	82
Totals ..	—	—	1,002,290	69	289,038	190,557	125,507	62,140	18,851	1,915

APPENDIX B—continued

Shipment.	Percentage of Cases Classified as						Estimated Wastage (Per cent.).
	I.	II.	III.	X.	XX.	Wasty	
1	1.5
2	1.7
3	2.3
4	3.3
5	2.2
6	2.4
7	2.3
8	1.9
9	2.8
10	4.0
11	2.2
12	4.1
13	4.1
14	4.0
15	4.0
16	2.6
17	3.1
18	3.3
19	5.7
20	7.5
21	5.6
22	2.9
23	3.6
24	11.9
25	11.8
26	6.4
27	7.5
28	4.7
29	8.1
30	7.8
31	6.8
32	6.0
33	8.2
34	7.1
35	9.5
36	6.6
37	7.8
38	8.0
39	9.6
Totals	5.6

APPENDIX C
CLASSIFICATION AND AVERAGE PERCENTAGE WASTAGE IN
PALESTINE ORANGE SHIPMENTS, 1929-30
(Extracted from "Hadar")

Ship- ment.	Date of Sailing.	Length of Voyage.	No. of Cases in Cargo.	Percentage of Cases Classified as					Estimated Wastage (per cent.)
				I	II	III	X	XX	
1	9.11	20	24,508	96.26	1.58	0.17	1.13	0.86	1.5
2	11.11	14½	24,746	100.00	—	—	—	—	1.0
3	14.11	16	23,120	100.00	—	—	—	—	1.0
4	17.11	14	21,925	97.74	0.74	0.71	0.04	0.77	1.34
5	21.11	14	28,400	98.70	0.8	0.20	0.2	0.1	1.10
6	23.11	16	26,620	91.25	4.25	3.0	1.50	—	1.5
7	25.11	15	27,261	100.00	—	—	—	—	1.0
8	2.12	14½	27,019	82.70	8.1	6.2	2.0	1.0	2.3
9	6.12	14½	27,682	77.22	14.05	7.32	1.34	0.07	2.07
10	15.2	20	28,870	30.52	27.88	22.13	14.04	4.52	7.09
11	18.12	17	29,802	19.00	41.0	20.0	14.0	6.0	7.82
12	21.12	15	27,565	36.70	25.2	22.2	11.6	4.3	6.48
13	23.12	14	16,500	31.00	34.0	27.0	7.0	1.0	4.75
14	27.12	12	31,323	27.80	24.8	24.4	17.4	5.6	8.12
15	28.12	19	30,886	33.80	25.0	22.0	12.86	6.34	7.49
16	30.12	16	27,341	20.76	28.14	28.32	18.32	4.46	7.19
17	3.1	17	30,886	14.00	29.0	39.0	14.0	3.0	7.65
18	5.1	16	27,341	23.00	51.0	16.0	8.0	2.0	5.36
19	8.1	15	34,441	31.40	26.4	22.2	15.4	4.6	7.32
20	8.1	16	24,044	32.33	34.35	21.61	10.38	1.33	5.46
21	12.1	15	31,135	41.0	34.0	15.0	9.0	1.0	4.68
22	14.1	12	35,354	51.8	27.5	14.2	5.3	1.2	3.93
23	19.1	19	31,791	28.0	30.0	25.0	10.0	3.0	6.08
24	24.1	18	34,621	60.6	—	25.7	9.0	4.7	—
25	25.1	21	22,048	21.0	52.0	18.0	8.0	1.0	5.16
26	27.1	20	29,250	31.0	31.0	20.0	3.0	1.0	3.79
27	29.1	16	35,527	38.20	36.54	19.49	5.51	0.20	7.28
28	1.2	18	30,530	65.7	—	27.30	5.9	1.1	—
29	3.2	15	20,245	81.8	—	16.3	1.5	0.4	—
30	3.2	20	32,199	40.32	35.87	18.09	5.11	0.61	4.14
31	7.2	17	39,105	34.0	52.0	9.0	4.0	1.0	4.91
32	8.2	16	29,556	82.9	—	14.9	1.9	0.3	—
33	9.2	15	29,797	56.0	37.0	5.0	1.0	1.0	2.85
34	11.2	24	9,900	38.0	44.0	14.0	2.0	1.0	3.70
35	16.2	18	34,233	40.0	27.64	21.10	8.46	2.80	5.48
36	17.2	15	35,699	63.6	—	27.8	6.4	2.2	—
37	20.2	18	32,040	20.0	30.0	33.0	14.0	3.0	7.30
38	21.2	16	36,203	26.0	51.0	14.0	7.0	2.0	5.07
39	25.2	13½	36,599	64.2	—	29.1	5.1	1.6	—
40	27.2	20	30,217	42.24	35.45	17.9	4.25	0.16	3.81
41	4.3	17	34,182	36.0	35.0	14.0	3.0	2.0	3.91
42	6.3	18	10,000	79.3	12.8	5.1	2.0	0.8	2.27
43	7.3	17	37,306	41.32	29.79	17.48	8.48	2.93	5.35
44	6.3	15	20,025	28.0	47.0	16.0	8.0	1.0	4.90
45	11.3	17	30,146	37.0	47.0	11.0	4.0	1.0	3.91
46	13.3	15	29,118	34.0	36.0	26.0	4.0	—	4.25
47	18.3	19	26,660	31.0	56.0	9.0	3.5	0.5	3.75
48	19.3	13	30,506	55.47	30.18	12.35	1.85	0.15	2.62
49	24.31	21	30,640	70.6	—	24.8	3.5	1.1	—
50	27.3	14	25,848	28.5	56.25	11.5	3.25	0.5	3.87
51	31.3	16	19,363	43.0	43.0	11.0	1.5	1.5	3.59
52	2.4	14	26,242	78.8	—	16.3	3.0	1.9	—
53	8.4	13	24,992	55.19	31.27	11.23	2.15	0.16	2.93

APPENDIX D
CLASSIFICATION AND AVERAGE PERCENTAGE WASTAGE IN
PALESTINE ORANGE SHIPMENTS, 1930-31
(Extracted from "Hadar")

Ship-ment.	Date of Sailing.	Length of Voyage.	No. of Cases in Cargo.	Percentage of Cases Classified as					Estimated Wastage (per cent.)
				I	II	III	X	XX	
1	6.11	17	17,618	87.20	—	3.70	6.90	2.20	—
2	13.11	14	28,003	90.00	—	5.70	2.80	1.50	—
3	14.11	12	25,509	86.39	1.50	3.51	6.52	2.53	2.3
4	21.11	15	14,207	95.60	—	1.90	1.50	0.32	—
5	23.11	19	11,460	94.60	1.22	2.42	1.44	—	—
6	27.11	14	25,956	82.50	12.00	1.50	4.00	—	—
7	28.11	12	27,363	91.0	4.00	4.00	1.00	—	1.5
8	28.11	12	28,093	98.80	—	0.70	0.30	0.20	—
9	28.11	16	32,346	54.76	27.34	11.89	5.60	0.39	3.5
10	3.12	13	35,893	91.10	—	6.00	1.90	1.00	—
11	11.12	16	29,768	66.49	—	28.27	3.47	0.77	—
12	12.12	15	29,050	95.00	3.00	2.00	—	—	—
13	16.12	14	28,757	74.00	18.00	5.00	2.50	0.50	2.4
14	18.12	15	23,291	84.40	—	13.20	1.70	0.70	—
15	18.12	13	29,120	68.55	22.45	5.84	2.62	0.54	2.6
16	21.12	14	31,731	91.59	—	7.00	0.91	0.50	—
17	23.12	19	23,715	43.43	32.86	18.25	5.03	0.43	4.0
18	25.12	16	25,854	83.60	—	14.30	1.20	0.90	—
19	27.12	16	28,272	62.00	24.00	12.00	2.00	—	2.7
20	28.12	14/16*	23,626	90.00	—	8.00	1.00	1.00	—
21	29.12	15	29,681	79.30	—	17.70	2.10	0.90	—
22	3.1	14	28,533	68.78	—	28.19	2.92	0.11	—
23	5.1	14	26,886	68.20	—	26.50	4.20	1.10	—
24	7.1	15	20,756	82.00	—	14.00	2.00	2.00	—
25	10.1	14	21,443	75.00	12.00	11.00	2.00	—	2.3
26	11.1	17	21,846	68.70	—	25.60	4.70	1.00	—
27	11.1	17	20,273	68.39	—	24.60	5.92	1.09	—
28	14.1	18	19,582	67.50	—	25.00	6.50	1.00	—
29	16.1	16	22,249	84.40	—	13.70	1.50	0.40	—
30	17.1	16	20,541	63.00	—	34.00	3.00	—	—
31	24.1	17	23,004	61.60	—	27.90	7.50	3.00	—
32	26.1	16	20,760	69.60	—	27.40	2.70	0.30	—
33	26.1	15	27,361	60.35	—	30.56	7.56	1.84	—
34	2.2	15	26,843	65.00	—	24.00	6.50	4.50	—
35	6.2	19	13,975	66.49	—	28.27	4.47	0.77	—
36	7.2	21	8,313	70.80	—	24.60	3.20	1.40	—
37	7.2	15	28,217	61.60	—	29.30	6.30	2.80	—
38	10.2	18	25,595	55.56	—	30.54	10.44	3.46	—
39	14.2	15	25,032	63.30	—	29.20	6.00	1.50	—
40	15.2	14	28,868	50.00	—	31.00	13.00	6.00	—
41	17.2	19/22*	12,654	58.90	—	29.50	7.70	3.90	—
42	21.2	13	25,142	52.35	—	33.49	11.21	2.96	—
43	25.2	19	21,787	42.62	—	33.41	18.35	5.62	—
44	27.2	16	27,280	46.40	—	33.90	13.80	5.90	—
45	28.2	15	28,815	73.00	—	22.00	3.00	2.00	—
46	1.3	17/21*	14,794	70.00	—	18.00	8.00	4.00	—
47	6.3	12	30,456	59.80	—	31.90	7.50	0.80	—
48	8.3	13	27,505	40.83	—	36.66	19.30	3.21	—
49	9.3	18	20,994	61.40	—	29.80	7.30	1.50	—
50	11.3	14	35,610	51.50	—	34.50	11.50	2.50	—
51	15.3	14	26,373	58.20	—	33.10	6.90	1.80	—
52	16.3	16/20*	12,534	59.19	—	26.82	11.48	2.51	—
53	23.3	13	22,043	70.94	—	16.94	8.80	3.32	—
54	24.3	15	34,903	49.10	—	36.30	9.80	4.80	—

E.M.B. 69

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CANNED AND DRIED FRUIT SUPPLIES IN 1932

Prepared in the Statistics and
Intelligence Branch of the
Empire Marketing Board



JUNE, 1933

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FOREWORD

In "Canned and Dried Fruit Supplies in 1931," which was issued in July last year, all the available statistical information on supplies of these commodities in the United Kingdom was brought together. The scope of the survey was also extended to include production and export statistics for a number of countries whose supplies form an important part of the world trade in canned and dried fruits.

The present volume reviewing the position in 1932 follows similar lines. The statistics for the previous year have been revised where necessary and the 1932 figures added, but it should be remembered that in practically every case statistics for 1932 are provisional and subject to revision.

Statistics and Intelligence Branch,
Empire Marketing Board.

May, 1933.

CANNED AND DRIED FRUIT SUPPLIES IN 1932

PART I.—CANNED FRUITS AND VEGETABLES

UNITED KINGDOM PRODUCTION

In the past five years the annual supply of canned fruits in this country has averaged over 3 million cwts., equivalent, at a conversion rate of 45 lbs. to the standard case to about $7\frac{1}{2}$ million cases. The maximum in this period and the largest on record, occurred last year when the total supply amounted to about 3,800,000 cwts. or $9\frac{1}{2}$ million cases. The bulk of the annual supply consists of imported apricots, peaches, pears and pineapples, with smaller quantities of other fruits, but the output of the home canning industry forms an increasing proportion, and in 1932 probably accounted for as much as one-sixth of the total.

I.—ENGLAND AND WALES

At the close of 1932, 72 factories were canning fruits and vegetables in England and Wales, and of these 52 were registered packers under the National Mark. These figures compare with 59 and 38 for the previous year.

A number of new factories were erected and several existing factories were extended in 1932 by National Mark canners and it is also significant that practically all new canners, some operating on a large scale, enrolled in the National Mark Scheme. This feature of the year's operations indicated a definite recognition of the importance attached by canners to the use of the National Mark. There was every indication that the progress made in 1932 would continue to be satisfactory, but it has lately become evident that economic and other conditions are tending to slow down temporarily the rate of increase.

In dealing with the progress of this industry, as indicated by the output, the main requisites are adequate and accurate statistics. So far, efforts to obtain reliable figures have failed and any figures given

must necessarily be merely approximate and should be accepted with reserve. From such information as is available the output in 1932, as estimated by the Ministry of Agriculture and Fisheries, was :—

Fruit..	..	..	..	..	600,000 cwt.
Vegetables	..	..	..	..	300,000 cwt.
Reprocessed Vegetables	..	..	..	..	700,000 cwt.

Varieties Canned

The chief varieties of fruits canned in Great Britain are those which are not, as a rule, imported in large quantities. Peaches, pears, apricots and pineapples account for five-sixths of all canned fruits in syrup imported into this country, and most of the balance is made up of canned fruit salad, the chief constituents of which are peaches, pears, apricots and pines. Canned fruits home grown, on the other hand, include the following varieties:—

Fruits

Strawberries.	Gooseberries.
Raspberries.	Plums, Red, Yellow and
Red Currants.	Purple, Victoria.
Raspberries and Red Currants.	Greengages.
Black Currants.	Damsons.
Loganberries.	Cherries (Sweet and Morello).
Blackberries.	Apples.
Blackberries and Apples.	Fruit Compote and Rhubarb.

As regards canned vegetables, the principal kind imported is tomatoes. But, apart from this, the Home pack competes directly with the chief imported descriptions, the British canned vegetable output including the following:—

Vegetables

Asparagus	Brussels Sprouts.
Runner Beans.	Celery.
French Beans.	Sea Kale.
Carrots.	Spinach.
Beetroot.	Cauliflowers.
Parsnips.	Mushrooms.
Turnips.	Macedoine of Vegetables.
Leeks.	Baked Beans with Pork.
New Potatoes.	Peas.

By far the most important of the canned vegetables produced in English factories are peas and baked beans. The former include a considerable proportion of fresh-picked peas canned under the National Mark, as well as peas, both fresh-picked and dried, not canned under the National Mark.

There was, however, a considerable increase in the output of other vegetables under the National Mark in 1932, and it is clear that considerable progress has been made in the variety and extent of canned vegetables.

The experience gained in the administration of the National Mark Scheme has indicated the value attached to a standardised product. At the same time, it has become obvious that there is need for a much greater uniformity in the packs of canned fruit and vegetables produced by English canners if they are to command full public confidence. With a view to securing more uniformity in National Mark packs, definite standards as regards size of fruits, syrup strengths and weight of fruit in cans are being prescribed. During the 1933 season authorised canners will be expected to adopt these standards so far as possible and samples will be examined and judged on this new basis. It is intended that these standards, amended if necessary as a result of the experience gained in the 1933 season, shall be made statutory as soon as possible after the end of that season.

The main problems at present confronting the industry in this country are those of securing an adequate supply of fruit and vegetables for canning, and of achieving a greater degree of unity in marketing policy to keep pace with demand.

Bottled Fruit and Vegetables

It was mentioned in last year's review that the National Mark Bottled Fruit and Vegetables Scheme would come into operation in 1932. For various reasons, however, its operation in that year was of a limited and experimental nature. It is intended that, as a result of the experience gained in 1932, the scheme shall be in full operation in 1933, and it is expected, in consequence, that an appreciable quantity of bottled fruits and vegetables will be disposed of under the National Mark. In 1932, 27 bottlers, owning 41 factories, enrolled in the scheme but, owing to the failure of the plum crop and other causes, a number of authorised bottlers were unable to apply the

National Mark to their products. It is hoped that with the removal of the adverse circumstances operating in 1932 more bottlers will take advantage of the benefits of the National Mark Scheme.

II.—SCOTLAND

The expectation of development of the fruit-canning industry in Scotland during the season of 1932 was fully realised. Each of the five existing factories had made arrangements to increase its output by extending its premises, and to introduce new machinery and additional canning lines, while two new factories established at Carluke and Blairgowrie, centres of the small fruit-growing industry, began operations.

As a result the total output of Scottish canned fruit in 1932 showed a very large increase over that of 1931. It is estimated that approximately 1,000 tons of raspberries, 60 tons of strawberries, 90 tons of plums, greengages and damsons, 6 tons of gooseberries and 10 tons of currants were canned in Scottish factories during 1932. The output in cans is calculated to have been :—raspberries, 3,697,000 ; strawberries, 276,000 ; plums, greengages and damsons, 250,000 ; gooseberries, 21,500 ; and currants, 60,500—a total of 4,305,000 cans of fruit.

Further development of the industry depends to a very great extent on the availability of adequate supplies of fruit suitable for canning. Already some of the canning firms have entered into contracts with growers for future supplies, and it is possible that the increased demand and the remunerative prices realised in 1932 may induce growers to increase their acreages under small fruit.

One of the fruit-canning firms undertook for the first time the canning of vegetables, while another firm that has hitherto confined its activities mainly to the canning of fish, packed a much larger quantity of vegetables during 1932. The vegetables canned were beetroot, turnips, carrots, cabbage, parsnips and new potatoes, and, while the total weights packed amounted to some 40 tons only, the indications are that this side of the canning industry in Scotland may develop in the near future.

III.—NORTHERN IRELAND

Development of canning in Northern Ireland has not taken place to the same extent as in England and Wales and Scotland, although

the advantages of a canning industry as an alternative market for growers of fruit and vegetables are fully recognised. The canning of fruits is undertaken on a small scale, but up to the present, attention has been confined almost entirely to apples, and no definite signs of expansion were evident during 1932. It is understood, however, that plans have recently been concluded for the opening of a new factory in the Belfast district, and that apples, plums, berries and currants, and peas and beans will be among the fruits and vegetables canned.

UNITED KINGDOM EXPORTS OF CANNED FRUITS AND VEGETABLES

Especially when compared with the very large quantities annually imported, the export trade in fruit and vegetables, canned and bottled, in the United Kingdom is, as yet, on a small scale, but the figures for 1931 (the latest available) show increases as compared with the previous year.

Leaving out of account the unusually heavy figure for 1927, exports of canned and bottled fruits preserved in sugar for the years 1926 to 1930 averaged 2,700 cwts., and in 1931 there was a distinct increase to over 3,400 cwts. The trade in canned and bottled fruit, preserved without sugar, however, shows marked signs of declining, the total of 4,000 cwts. for 1931 being lower than in any of the previous five years.

Exports of canned and bottled vegetables are also still comparatively small, but there has been a very distinct upward trend in recent years. Total exports in 1931 were considerably in excess of any previous year and amounted to 8,200 cwts. as compared with 7,100 cwts. in 1930, an advance of 15 per cent. Previous to 1931, separate particulars were available only for the small exports of canned tomatoes. The details now published show that over 60 per cent. of the 1931 total consisted of canned peas, exports of which amounted to 4,977 cwts., while the remainder was composed of 98 cwts. of canned tomatoes, 3,075 cwts. of other sorts of canned vegetables, and 25 cwts. of bottled vegetables.

The bulk of the exports of both canned and bottled fruits and vegetables are consigned to Empire countries. Particulars of exports in the years 1926 to 1931 are shown in the table on page 10.

*Exports of Canned and Bottled Fruits and Vegetables from the
United Kingdom*

Description.	1926.	1927.	1928.	1929.	1930.	1931.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Canned or bottled fruit :—						
Preserved in sugar	2,453	11,917	2,844	2,869	2,672	3,418
Preserved without sugar ..	4,693	4,363	5,002	5,037	4,543	4,002
Total	7,146	16,280	7,846	7,906	7,215	7,420
Canned or bottled vegetables ..	5,245	3,843	5,033	5,908	7,104	8,175

**IMPORT DUTIES ON CANNED FRUITS AND VEGETABLES
AND DRIED FRUITS**

I.—CANNED FRUITS

Prior to 1st March, 1932, canned fruits (other than the very small quantities of canned fruit of dutiable kinds) were admitted free except for a duty on the sugar content of the syrup, supplies from the Empire entering at preferential rates. On 1st March, 1932, a duty of 10 per cent. *ad valorem*, inclusive of the duty on the syrup, was imposed on imports of foreign canned fruits. Empire produce was exempt, except for the duty on sugar content at the preferential rate.

Following the Imperial Economic Conference at Ottawa, new rates of duty on foreign produce came into force for certain classes of canned fruits as from 17th November, 1932 (Ottawa Agreements (No. 1) Order, 1932). The new duties superseded the existing general *ad valorem* duties chargeable under the Import Duties Act, 1932, but were additional to any other Customs duty. The effect was to make the duties chargeable as follows :—

Apples preserved in syrup—3s. 6d. per cwt. in addition to duty in respect of sugar content.

Other fruits (except stoned cherries) preserved in syrup—15 per cent. *ad valorem* in addition to the duty on sugar content.

Stoned cherries, preserved in syrup, were provided for in the Additional Import Duties (No. 6) Order, 1932, effective from 6th September, 1932, which made, with those previously in force a total duty chargeable at the following rate :—

Cherries, drained or glacé, and crystallised or Metz ; stoned cherries preserved in syrup, with or without flavouring matter, in tins or bottles : 25 per cent. ad valorem in addition to the duty in respect of sugar content.

It is provided in respect of all the above categories that goods consigned from and grown, produced or manufactured in any part of the British Empire are exempt from the new duties, but are liable to duty at the preferential rate on the sugar content.

II.—FRUIT PULP

Imports of fruit and fruit pulp preserved without sugar in cans or bottles and other containers were not liable to duty before 1st March, 1932. The only fruit pulp on which a duty was imposed was fruit pulp preserved in syrup, imports of which are small.

The general duty of 10 per cent. *ad valorem* came into effect on 1st March, 1932, on imports of foreign fruit and fruit pulp preserved without sugar, but this was raised, as from 26th April, 1932, by Additional Import Duties (No. 1) Order, 1932, which provided as follows :—

Fruit preserved by chemicals or artificial heat, other than fruit preserved in sugar—an additional duty of 15 per cent. ad valorem, making with the duty previously in force a total of 25 per cent. ad valorem.

III.—CANNED VEGETABLES

By the Additional Import Duties (No. 1) Order, 1932, it was provided that the following import duties on foreign produce should come into operation as from 26th April, 1932 :—

Vegetables (other than tomatoes) preserved in air-tight containers, but not including pickles and vegetables preserved in vinegar—An additional duty of 10 per cent., making with the duty previously in force, a total of 20 per cent. ad valorem.

The duty on canned tomatoes remains at 10 per cent. *ad valorem*.

IV.—DRIED FRUITS

The rate of duty on currants of 2s. per cwt. was determined by the commercial treaty with Greece and has been in force since 1890. This rate cannot be varied during the currency of the agreement, but Empire supplies have been admitted free since 1st July, 1925. The only other duties on dried fruits, before 1st March, 1932, were on raisins, figs and fig-cake, and plums and prunes, amounting to 7s. per cwt., Empire fruit entering free of duty.

On 1st March, 1932, a duty of 10 per cent. *ad valorem* was imposed on imports of foreign dried apples, pears, peaches, nectarines and dates, and this was subsequently raised, as from 26th April, 1932, to 25 per cent. *ad valorem*. By the Ottawa Agreements (No. 1) Order, 1932, an addition of 3s. 6d. per cwt. was made to the duty on foreign raisins, figs and fig-cake, and plums and prunes, making 10s. 6d. per cwt. in all.

Early this year, as the result of recommendations made by the Import Duties Advisory Committee the duties chargeable on foreign dried apples, pears, peaches, and nectarines, were revised, the rate applicable as from 28th February, 1933, being brought into line with the duty on raisins, figs and fig-cake, etc., viz. 10s. 6d. per cwt. By the same Order (Additional Import Duties (No. 1) Order 1933) the duty on dates was reduced from 25 per cent. *ad valorem* to 10 per cent. *ad valorem*.

The duties on foreign dried fruits at present (May 1933) in force are, therefore, as follows :—

Currants—2s. per cwt.

Figs and fig-cake, plums (commonly called French plums and prunelloes), plums, not otherwise described (including apricots), prunes, raisins, dried apples, dried pears, dried peaches and dried nectarines, 10s. 6d. per cwt.

Dates—10 per cent. *ad valorem*.

As in the case of canned fruits, goods consigned from and grown, produced or manufactured in any part of the British Empire are exempt from these duties.

IMPORTS OF CANNED AND BOTTLED FRUITS

Although the canned fruit industry in this country has been rapidly developing in recent years, there have been no signs of a

falling off in the large quantities of canned fruit in syrup annually imported. In 1932, record figures were again attained, and the quantity imported totalled over 3,200,000 cwts., having a declared value of more than £6,000,000.

Until 1930, pineapples were the only variety of canned fruit, preserved in syrup, to be separately distinguished in the Trade Returns of the United Kingdom, and all other categories were classified under the general heading of "Other Sorts." More detailed particulars are available for 1930, 1931 and 1932, and some of these are set out on pages 21 to 36, but in order that a comparison may be made with earlier years all canned fruits have been grouped in Tables I and II into these two classes.

Table I shows the quantity and value of annual imports into the United Kingdom of canned and bottled pineapple and other sorts of fruit, preserved in sugar, during the past nine years.

TABLE I.—*Imports into the United Kingdom of Canned and Bottled Fruits preserved in syrup.*

Year.	Pineapples.		Other Sorts.	
	Quantity.	Value.	Quantity.	Value.
	Thousand cwts.	Thousand £	Thousand cwts.	Thousand £
1924	618	1,388	1,482	4,417
1925	746	1,490	1,782	5,912
1926	608	1,182	1,627	4,672
1927	596	1,209	1,495	3,823
1928	630	1,161	1,979	4,886
1929	766	1,320	1,954	5,084
1930	698	1,067	1,732	4,300
1931	769	1,053	2,177	4,431
1932	982	1,256	2,247	4,794

It will be seen that more than a quarter of the total imports consist of pineapple, which has a considerably lower average value than that of "Other Sorts." Imports of both classes have a distinctly upward tendency, and in 1932 were heavier than in 1931, but pineapple showed much the more substantial advance.

Table II shows for the past six years the quantities of canned and bottled pineapple and other sorts of fruit imported from the various countries of consignment.

TABLE II.—*Imports into the United Kingdom of Canned and Bottled Fruits, preserved in syrup.*

Country of Consignment.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
<i>Pineapples.</i>						
Malaya	473	515	648	608	676	911
Union of South Africa	16	12	13	4	5	4
Other Empire countries	2	1	—	2	3	14(a)
United States	69	48	58	40	35	32
Hawaii	34	49	44	38	47	19
Other Foreign countries	2	5	3	6	3	2
Total Empire countries	491	528	661	614	684	929
Total Foreign countries	105	102	105	84	85	53
Total	596	630	766	698	769	982
<i>Other Sorts.</i>						
Australia	19	175	136	230	208	231
Canada	27	25	34	20	23	53
Union of South Africa ..	2	8	8	25	5	28
Other Empire countries	3	4	4	3	1	5
United States	1,375	1,700	1,689	1,379	1,868	1,824
Italy	46	41	48	50	49	56
Spain	5	4	11	4	1	8
Netherlands	2	4	7	2	3	5
France	7	7	7	6	5	3
Belgium	3	3	2	3	1	4
Switzerland	2	2	2	3	2	3
Other Foreign countries	4	6	6	7	11	27(b)
Total Empire countries	51	212	182	278	237	317
Total Foreign countries	1,444	1,767	1,772	1,454	1,940	1,930
Total	1,495	1,979	1,954	1,732	2,177	2,247

(a) Including Australia 10.

(b) Including Chile 12 and Russia 4.

The most striking feature of the year 1932 was the increase in supplies of canned fruit from Empire countries, which advanced by 35 per cent. from 920,000 cwts. in 1931 to 1,250,000 cwts. in 1932. The larger Empire consignments were chiefly pineapples from Malaya. Supplies from Australia also increased from 210,000 cwts. in 1931 to over 240,000 cwts. in 1932, while Canadian shipments rose from 23,000 to 53,000 cwts., and South African from 11,000 to 32,000 cwts. On the other hand, imports from the United States (including Hawaii) fell from 1,950,000 cwts. in 1931 to 1,880,000 cwts. in 1932.

Nearly 95 per cent. of the canned pineapple imports in 1932 were obtained from Empire countries, and actually 93 per cent. were from British Malaya. Imports from that country increased from a previous record total of 676,000 cwts. in 1931 to no less than 911,000 cwts. in 1932, representing an advance of 35 per cent. Imports from other Empire sources are of little importance in the total, but a notable feature of the year was the striking increase in supplies from Australia from 1,600 cwts. in 1931 to 10,300 cwts. in 1932. A new feature in 1932 was shipments from Mauritius totalling 500 cwts. The remainder consisted mainly of small supplies from South Africa (4,400 cwts.) and Fiji (1,700 cwts.). The relatively small imports of canned pineapple from foreign sources, practically the whole of which comes from Hawaii and the United States, are yearly showing a percentage decline.

The position is reversed in the case of "Other Sorts" of canned fruit, of which 86 per cent. were obtained in 1932 from foreign countries, mainly the United States. Some 50,000 cwts. are regularly received each year from Italy. The remaining foreign supplies consist mainly of small quantities from other European countries, but an interesting feature in 1932 was the arrival of 12,000 cwts. from Chile, which had previously sent only small quantities. Among Empire countries, Australia is the chief shipper of "Other Sorts" to the United Kingdom, and in 1932, imports from that source were slightly greater than in any previous year. Canadian supplies were more than double those of 1931. The remaining quantities were mainly from the Union of South Africa, which also supplied much more than in 1931.

Imports of canned fruit fluctuate considerably from month to month, mainly as the result of the different packing seasons and the varying output of the countries responsible for the supplies, but no

such pronounced seasonal movement is apparent as in the case of perishable commodities like fresh fruits. In the past three years no very distinct seasonal trend can be traced, but in each year a low point was reached in May. In 1930 and 1931 that month was the period of minimum imports, but in 1932, December was slightly lower in consequence of the re-action following the exceptionally heavy imports in October which resulted from the record shipments from California in the previous month. In each year a high point was attained in July or August. In 1930, July was the month of maximum import, but in 1931 and 1932, although imports in that month were on a high level the peak was reached in November and October respectively. The trend is mainly determined by the course of shipments from the United States and Malaya; American exports are usually at their lowest in April and May, and reach their maximum in the autumn months, while as regards Malaya, October and November are generally months of small shipment, the peak occurring in May or June.

Monthly imports in 1932 are given in Table III, in which separate details for the individual fruits are also shown.

TABLE III.—*Monthly Imports into the United Kingdom of Canned and Bottled Fruits, preserved in syrup, in 1932.*

Month.	Apricots.	Peaches.	Pears.	Pine-apples.	Currants and Berries.	Plums.	Other Sorts.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January..	10·5	30·8	42·9	75·2	1·2	0·6	21·2	182·4
February	6·8	26·4	41·0	117·0	3·2	0·3	30·4	225·1
March ..	9·9	32·5	56·8	82·3	3·7	0·2	29·6	215·0
April ..	15·3	41·8	69·5	84·6	3·7	0·4	26·4	241·7
May ..	18·3	30·6	35·6	63·5	3·5	1·6	24·8	177·9
June ..	17·2	49·1	49·2	125·6	4·5	0·1	24·9	270·6
July ..	20·7	45·3	38·9	96·5	3·6	0·1	50·6	255·7
August ..	47·4	53·1	32·7	114·5	7·3	0·1	37·3	292·4
September	24·6	105·5	34·9	66·0	10·7	0·2	38·4	280·3
October	49·3	250·7	174·9	68·8	9·9	0·4	93·7	647·7
November	16·8	62·4	104·9	42·8	7·2	0·4	36·6	271·1
December	7·4	31·8	68·2	45·4	1·2	3·4	12·8	170·2
Total ..	244·2	760·0	749·5	982·2	59·7	7·8	426·7 (a)	3,230·1

(a) Includes small quantities of fruit in thick syrup, totalling 2,400 cwts. (France, 1,600 cwts., Canada, 200 cwts., and United States, 300 cwts.).

In Table IV monthly imports have been expressed in cases. Apricots, peaches, pears, pineapples other than Malayan, plums, and other sorts have been converted into standard case at 45 lbs. to the case (24 No. 2½ cans). The bulk of the Malayan canned pineapples come in cases of 48 1½ cans with a net weight of about 57 lbs. and the average rate of conversion used for these is 56 lbs. per case, while for currants and berries the case of 24 No. 2 cans, weighing about 30 lbs. net, has been taken. In this table the small imports of canned fruit in thick syrup have been omitted.

TABLE IV.—*Monthly Imports of Canned and Bottled Fruits, preserved in thin syrup, into the United Kingdom in 1932.*

Month.	Apri- cots.	Peaches.	Pears.	Pine- apples.	Cur- rants and Berries.	Plums.	Other Sorts.	Total.
	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.
January ..	26.1	76.8	106.9	153.7	4.5	1.4	52.4	421.8
February..	16.9	65.7	102.2	237.2	11.9	0.7	75.0	509.6
March ..	24.6	80.9	141.3	166.5	13.9	0.5	73.1	500.8
April ..	38.1	104.1	173.0	171.8	14.0	1.0	65.1	567.1
May ..	45.6	76.1	88.5	128.9	13.0	4.2	61.4	417.7
June ..	42.8	122.3	122.6	252.8	16.9	0.1	61.6	619.1
July ..	51.6	112.8	96.9	195.8	13.5	0.2	125.4	596.2
August ..	118.3	132.3	81.3	230.6	27.2	0.2	92.4	682.3
September	61.1	262.6	87.2	133.4	40.0	0.4	95.4	680.1
October ..	122.8	624.4	435.5	143.3	36.9	1.1	232.8	1,596.8
November	41.7	155.3	261.0	90.9	26.7	1.1	90.5	667.2
December	18.5	79.1	169.8	94.6	4.4	8.6	31.2	406.2
Total ..	608.1	1,892.4	1,866.2	1,999.5	222.9	19.5	1,056.3	7,664.9

Over half the imports into this country of canned and bottled fruits preserved in syrup consist of apricots, peaches and pears, and these three fruits, with pineapples account for about five-sixths of the total imported supplies. It is convenient, therefore, in view of their importance to consider these fruits and the group of miscellaneous fruits in greater detail, and this has been done in the three

following chapters. But, in the meantime it seems desirable to anticipate, to a certain extent, the analysis given later, and to indicate at this stage the relative importance of the different fruits or groups of fruits in the total imports.

Imports of canned fruits preserved in syrup in 1932, amounted to 3,230,100 cwts., and of this total pineapples formed the largest proportion accounting for 30.4 per cent., as compared with 26.2 per cent. in 1931, when they also stood first in the list. Peaches were next in importance in 1932, the proportion amounting to 23.5 per cent. against 24.9 per cent. in 1931, and pears followed with 23.2 per cent. as compared with 25.2 per cent. in 1931. Figures shewing the position of the different fruits or groups of fruits are given in Table V.

TABLE V.—Percentage of different varieties in total imports—years 1930 to 1932.

Year.	Pine-apples.	Peaches.	Pears.	Apricots.	Currants and Berries.	Plums.	Other Sorts.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1930	28.7	25.2	20.6	8.7	(a)	(a)	16.8
1931	26.2	24.9	25.2	7.2	2.4	0.3	13.8
1932	30.4	23.5	23.2	7.6	1.9	0.2	13.2

(a) Included in "Other Sorts."

In the composite group classified as "Currants and Berries" loganberries are the principal item and in 1932 amounted to about $1\frac{1}{4}$ per cent. of the total of all fruits; small quantities of black and red currants and berries such as bilberries, blackberries, gooseberries, raspberries and strawberries were also included in this group.

Of the miscellaneous fruits, accounting in 1932 for over 13 per cent. of the total imports, fruit salad was undoubtedly the most important and is estimated to have represented between 8 and 9 per cent., or rather more than the proportion of apricots. Grape-fruit and cherries each accounted for about 2 per cent. and the balance was made up

of small quantities of a number of fruits including oranges, figs, grapes, guavas, passion fruit, quinces, raisins and rhubarb; oranges and figs were by far the most important.

Imports of Bottled Fruits

The figures set out in the preceding tables include imports of bottled as well as canned fruits. Prior to 1931 there were no separate figures for these two classes, but details of imports of bottled fruits are available for 1931 and 1932, and these are given for the latter year in Table VI.

The quantity imported in bottles is surprisingly small, especially when compared with the enormous total of the canned varieties. In 1932, the total barely exceeded 1,300 cwts., which was, however, nearly double the aggregate of 700 cwts. for the year 1931. Nearly half of the 1932 total consisted of peaches from the United States, which country also supplied the whole of the pears and the small quantity of apricots.

TABLE VI.—*Imports of Bottled Fruits, preserved in thin syrup, in 1932.*

Country whence consigned.	Apricots.	Peaches.	Pears.	Pine-apples.	Other Sorts.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Malaya	—	—	—	155	—	155
Other Empire Countries ..	—	—	—	—	8	8
United States	1	617	161	—	91	870
Belgium	—	—	—	—	148	148
France	—	—	—	—	60	60
Netherlands	—	—	—	—	33	33
Switzerland	—	—	—	—	21	21
Italy	—	—	—	—	21	21
Total	1	617	161	155	382	1,316

The value of imports of canned and bottled fruits in the past three years is given in Table VII. As already mentioned, prior to 1930 separate details were available only for pineapples.

TABLE VII.—*Value of Imports of Canned and Bottled Fruits preserved in syrup.*

Fruit.	1930 (Canned and Bottled).	1931.		1932.	
		Canned.	Bottled.	Canned.	Bottled.
Apricots	£ 442,937	£ 375,701	£ 165	£ 462,634	£ 9
Peaches	1,309,007	1,261,887	225	1,364,429	1,157
Pears	1,253,476	1,455,902	157	1,601,318	340
Pineapples	1,066,813	1,052,567	50	1,255,971	181
Currants and Berries..	(a)	192,109	(a)	145,347	(a)
Plums	(a)	13,770	(a)	13,696	(a)
Other Sorts	1,294,624	1,129,009 (b)	2,221	1,203,748 (b)	1,616
Total	£ 5,366,857	5,480,945 (b)	2,818	6,047,143 (b)	3,303

(a) Included in "Other Sorts."

(b) May include small quantities bottled in thick syrup.

Average declared values in the years 1930 to 1932 are set out in Table VIII. The unit used in each instance is the cwt. as this provides the only definite means of comparison; no attempt has been made to convert into cases in view of the difficulty of arriving at a satisfactory conversion factor, particularly as regards pineapples and "other sorts". Bottled fruits are also included, but the quantities are so small that the averages are not materially affected.

Average declared values have been falling for some years. In 1924 the average for all fruits was 55s. 3d. per cwt. and by 1928 it had fallen to 46s. 6d., a decrease of about 16 per cent. There was a slight improvement in 1929 when the average rose to 47s. 1d., but there has since been a sharp decline, though there was some improvement in 1932.

TABLE VIII.—Average declared values (per cwt.) of Imports of Canned and Bottled Fruits—1930–1932.

Year.	Apricots.	Peaches.	Pears.	Pine-apples.	Currants and Berries.	Plums.	Other Sorts.	All Fruits.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
1930..	42 2	43 9	50 0	31 7	(a)	(a)	63 5	44 2
1931..	35 3	34 6	39 10	27 6	55 2	35 7	55 0	36 11
1932..	37 11	35 11	42 9	25 7	48 9	35 0	56 10	37 11

(a) Included in "Other Sorts."

IMPORTS OF APRICOTS, PEACHES AND PEARS

In 1932, imports of apricots and peaches both showed increases over the previous year's figures, and pears, which had risen 50 per cent. in 1931, were maintained at that year's level. The increase amounted to 15 per cent. for apricots, but was only moderate for peaches, being less than 4 per cent. above the large total for the previous year.

Foreign countries, principally the United States, as usual contributed much the larger share of each fruit. For peaches the proportion was greater than in 1931, but for apricots and pears, particularly the latter, there was a decline. Empire countries, the most important of which was Australia, accounted for about one-sixth of the apricots, one-fifth of the pears, and only one-eighth of the peaches. The main reason for the decline in the imports of peaches from Empire countries was the smaller Australian output last year. The heavy increase in pears reflected the much larger Australian pack, and, in addition, Canadian and South African supplies were much larger. With regard to apricots, imports from Australia were slightly lower than in 1931, in spite of a larger output, but the total from Empire sources was greater owing to an increase in supplies from South Africa.

Imports of the three fruits in 1931 and 1932 are shown in Table I.

TABLE I.—Imports into the United Kingdom of Canned and Bottled Apricots, Peaches and Pears, preserved in thin syrup.

Country of Consignment.	Apricots.		Peaches.		Pears.	
	1931.	1932.	1931.	1932.	1931.	1932.
	Thou. cwts.	Thou. cwts.	Thou. cwts.	Thou. cwts.	Thou. cwts.	Thou. cwts.
Australia	29·1	27·8	122·0	89·4	52·9	103·6
Canada	0·7	0·3	1·8	1·5	13·2	33·8
Union of South Africa	3·2	15·2	—	0·2	0·6	11·5
Other Empire Countries	—	0·1	0·1	0·4	0·5	0·4
United States	179·5	192·0	606·8	654·6	674·2	598·0
Other Foreign Countries	0·6	8·8	1·8	13·9	1·2	2·2
Total Empire Countries	33·0	43·4	123·9	91·5	67·2	149·3
Total Foreign Countries	180·1	200·8	608·6	668·5	675·4	600·2
Total	213·1	244·2	732·5	760·0	742·6	749·5
Percentage of Total from Empire Countries	15·5	17·7	16·9	12·0	9·0	19·9
Percentage of Total from Foreign Countries	84·5	82·3	83·1	88·0	91·0	80·1
Percentage of Total Imports of Canned Fruits of all kinds	7·2	7·6	24·9	23·5	25·2	23·2

Apricots

In most years apricots are imported all the year round from Australia and the United States, these two countries being the most important sources of supply. In the first three months of the year shipments from Australia are usually on a relatively small scale, but in April and May an increase is recorded, reflecting exports of the new season's pack. The maximum is generally reached between May and July, and this is followed by a gradual decline to the end of the year. This course was followed in 1932, but there was a slight revival in November and December.

Imports from the United States also exhibit a fairly regular seasonal trend. From the beginning of the year until May or June, when

normally the lowest point is reached, the tendency is usually downwards. August is generally the month of maximum import following the heavy movement of the new pack, on which operations commence in the last week of June, but a decline normally occurs in September, and November and December are generally months of moderate imports following a seasonal recovery in October. In 1931, contrary to the usual trend, there was a sharp rise in November and imports in the last two months of the year were more than twice as heavy as in the corresponding months of the previous year. The year 1932 was even more abnormal. Following the large imports in the latter part of 1931, a reaction occurred, and a low point was reached in February, 1932. In October the trend was again disturbed when the high total of 48,000 cwts. was attained as a result of the record shipments from California in the previous month. A rapid reverse followed and the minimum for the year was recorded in December.

Imports in the four months September to December accounted for 40 per cent. of the total in 1932 as compared with 41 and 28 per cent. for the same period in 1931 and 1930 respectively. It is probable that both of these exceptions to the normal trend were due to the anticipation of the imposition of additional import duties in this country.

Monthly imports of canned apricots in 1932 are set out in Table II.

TABLE II.—*Monthly Imports into the United Kingdom in 1932 of Canned and Bottled Apricots, preserved in thin syrup.*

Month.	Australia.	Union of South Africa.	Other Empire Countries.	United States.	Other Foreign Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	2·4	—	—	8·1	—	10·5
February	0·5	0·1	0·1	5·9	0·1	6·7
March	1·1	0·3	0·1	8·3	—	9·8
April	—	3·6	—	11·7	—	15·3
May	3·4	2·9	0·1	11·9	0·1	18·4
June	6·5	2·7	0·1	7·8	0·1	17·2
July	5·3	2·7	—	10·7	2·0	20·7
August	2·4	1·9	—	39·1	4·1	47·5
September	2·5	0·1	—	21·0	1·0	24·6
October	0·5	—	—	48·1	0·7	49·3
November	1·3	0·5	—	14·9	0·1	16·8
December	1·9	0·4	—	4·5	0·6	7·4
Total	27·8	15·2	0·4	192·0	8·8	244·2

Peaches

Australia and the United States are also the most important factors in the peach supply position. Imports of peaches from both sources arrive throughout the year, but as would be anticipated from the relative sizes of the packs of the two countries, fluctuations are more marked in the case of Australia.

Monthly imports of canned peaches in 1932 are shown in Table III.

TABLE III.—*Monthly Imports into the United Kingdom in 1932 of Canned and Bottled Peaches, preserved in thin syrup.*

Month.	Australia.	Canada.	Other Empire Countries.	United States of America.	Other Foreign Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	8.8	0.1	—	21.9	—	30.8
February	3.5	0.2	—	22.6	0.1	26.4
March	—	0.1	0.1	32.3	—	32.5
April	1.1	0.1	—	40.6	—	41.8
May	6.9	—	—	23.7	—	30.6
June	25.6	—	0.1	22.9	0.5	49.1
July	11.0	—	—	33.6	0.7	45.3
August	8.3	—	—	39.5	5.3	53.1
September	5.7	1.0	0.3	95.0	3.5	105.5
October	1.0	—	0.1	247.1	2.5	250.7
November	7.6	—	—	54.3	0.5	62.4
December	9.9	—	—	21.1	0.8	31.8
Total	89.4	1.5	0.6	654.6	13.9	760.0

The bulk of the imports of canned peaches from Australia is concentrated in the spring and summer months ; in 1930, 81 per cent. of the imports arrived in the five months May to September, while in 1931, 73 per cent. were received in the same period, and in 1932, 64 per cent. The season usually opens in April, when the first shipments of new pack fruit arrive, and the maximum import is reached in June or July. From August or September, depending largely on the size of the pack, a sharply declining tendency usually sets in, and the low point is reached in September or October. In 1931 and 1932, however, there was a revival in the closing months of each year.

Rather more than half of the annual imports of canned peaches from the United States were received in the second half of the year in both 1930 and 1931, while in 1932 about three-quarters of the total were imported in that period. The lowest point occurs normally during the months of May to July, although in 1932 slightly smaller totals were recorded in January and December, and the consistent upward trend does not start until August or September, or rather later than in the case of apricots, since the packing of peaches does not start until fully a month later, at the end of July. The maximum is reached in October or November; in 1931 it occurred in November, and in 1932, in October, when the enormous total of 247,000 cwts. was imported, or 38 per cent. of the supplies for the whole year.

Pears

Of the three countries mainly concerned in shipments of canned pears to this country, most of the imports from Canada and Australia are normally concentrated into relatively short periods, though, as a rule, some shipments arrive in every month throughout the year. In the case of the United States, while there are considerable fluctuations, distribution is more even, due mainly to the larger quantity of fruit available for export.

Though supplies in 1932 showed a marked advance on the previous year, imports of Canadian canned pears are still on a relatively small scale, and during the summer months arrivals in this country are of negligible proportions. The lowest point of the year normally occurs in August. Towards the end of the year the trade becomes more active, and the peak of the season is reached between December and February or March, after which imports are moderate, with a declining tendency.

In the early part of the year canned pear imports from Australia are usually at a low ebb, and the first shipments of new season's fruit begin to arrive in April. The maximum is reached between the months of May and July, and is generally followed by a fairly continuous decline to a low point in October or November, but as was observed in the case of apricots and peaches there was a revival in the closing months of both 1931 and 1932, which extended into the early part of the following years.

The canning of pears in California starts in the last week in July, or about the same time as the opening of the peach canning season. In the State of Washington operations do not commence until three

weeks later, while the Oregon canning season does not begin until early September. These factors naturally influence the export season, which is later than that for apricots and peaches. From May to September imports into this country are generally of smaller dimensions than at other times of the year. A sharp rise occurs in October, which was particularly marked in 1932, with the peak for the year either in that month or in November, but heavy shipments continue until the following March or April. Pear shipments are fairly evenly divided between the two halves of the year, but, as with peaches, the preponderance lies in the second half.

Monthly imports are shown in Table IV.

TABLE IV.—*Monthly Imports into the United Kingdom in 1932 of Canned and Bottled Pears, preserved in thin syrup.*

Month.	Australia.	Canada.	South Africa	Other Empire Countries.	United States of America.	Other Foreign Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	3.4	1.9	—	—	37.6	—	42.9
February	—	3.9	—	—	36.8	0.3	41.0
March ..	—	7.0	—	—	49.8	—	56.8
April ..	0.8	0.8	0.1	—	67.8	—	69.5
May ..	8.9	1.5	4.8	0.1	19.8	0.5	35.6
June ..	27.7	1.3	3.0	—	17.2	—	49.2
July ..	18.1	1.3	1.9	—	17.5	—	38.8
August..	15.6	0.2	1.2	—	15.1	0.7	32.8
September	9.6	0.2	0.1	—	25.1	—	35.0
October	1.7	1.9	0.2	0.2	170.2	0.7	174.9
November	6.9	1.7	0.1	0.1	96.0	—	104.8
December	10.9	12.1	0.1	—	45.1	—	68.2
Total	103.6	33.8	11.5	0.4	598.0	2.2	749.5

IMPORTS OF CANNED PINEAPPLE

In common with canned fruits as a whole, considerable growth has taken place in the United Kingdom imports of canned pineapple since the war. In 1932, imports reached the large total of 982,000 cwts. with a declared value of £1,256,000, representing an advance of 28 per cent. on the previous year's record total of 769,000 cwts. Compared with the average for the five years 1927-1931 (692,000 cwts.), imports

in 1932 showed an increase of 42 per cent. and were greater than the average for the five years 1922-1926 (561,000 cwts.) by 75 per cent. In the year 1913 only 270,000 cwts. of canned pineapple were imported.

Although the volume of canned pineapples imported increased considerably during the years 1921-1931 there was not much change in the relative position of this fruit in the United Kingdom import trade. In 1931, canned pineapple comprised 26.2 per cent. of the total imports of canned fruits preserved in syrup as compared with averages of 28.8 per cent. and 27.3 per cent. for the periods 1921-1925 and 1926-1930 respectively. But in 1932, in spite of increases in the quantities of other classes of fruit, the percentage of pineapple in the total rose to 30.4 per cent. As in the previous year, pineapples ranked first in importance, as can be seen from the following figures of the proportions of each of the principal fruits to total imports, the percentages for 1931 being given in brackets; pineapples, 30.4 (26.2); peaches, 23.5 (24.9); pears, 23.2 (25.2); and apricots, 7.6 (7.2).

In Table I are shown imports into the United Kingdom in the years 1927 to 1932, and for comparative purposes, the proportion of pineapples in the total imports.

TABLE I.—*Imports into the United Kingdom of Canned and Bottled Pineapple, preserved in thin syrup, 1927-32.*

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Union of South Africa	16.0	11.7	13.2	3.9	5.2	4.4
British Malaya	473.0	514.8	647.0	608.0	676.1	910.8
Other Empire countries	2.2	1.4	0.5	1.9	2.7	13.5(a)
Total Empire countries	491.2	527.9	660.7	613.8	684.0	928.7
United States and Hawaii	103.7	96.9	102.0	78.0	82.2	51.0
Other Foreign countries	1.6	5.3	3.0	6.5	2.6	2.5
Total Foreign countries	105.3	102.2	105.0	84.5	84.8	53.5
Total Canned Pineapple	596.5	630.1	765.7	698.3	768.8	982.2
<i>Pineapple Imports expressed as percentage of Total of all kinds</i>	28.5	24.1	28.2	28.7	26.2	30.4

(a) Includes 10.3 from Australia and 1.7 from Fiji.

There have been no significant alterations in the countries of supply in recent years, though the growing importance of Australia is worthy of note. There appears, however, to be some tendency to change in the proportions coming from different countries. Empire countries continue to take a large and growing share in the trade; in 1932 they accounted for nearly 95 per cent. of the total import, of which all but 2 per cent. came from British Malaya. But, while the proportion received from this source has tended to increase, and, in fact, made a considerable advance in 1932, the percentage of imports from South Africa has declined to small proportions in recent years. A similar movement is noticeable in the trend of supplies from Hawaii, practically the only foreign source of any consequence; between 1927 and 1932 the share of Hawaii actually declined from 17½ per cent. to little more than 5 per cent., the fall in 1932 being particularly severe.

These movements are shown in Table II below, in which imports from each country are expressed as percentages of the total imports of canned pineapples. It is probably too early to conclude that the declining imports from South Africa and Hawaii are a permanent feature of the supply position; in both cases the downward tendency may be the result of a temporary fall in the demand for a relatively high-priced article due to the depression in industry, though the improvement which has taken place in the quality of the Malayan product is probably a contributory factor of some importance.

TABLE II.—*Percentage of Imports of Canned Pineapple, preserved in thin syrup, into the United Kingdom from different countries of supply.*

Country whence Consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Union of South Africa	2·7	1·8	1·7	0·6	0·7	0·4
British Malaya	79·3	81·7	84·5	87·1	87·9	92·8
United States and Hawaii	17·4	15·4	13·3	11·1	10·7	5·2
Other countries	0·6	1·1	0·5	1·2	0·7	1·6
Total Empire countries	82·3	83·8	86·3	87·9	89·0	94·6
Total Foreign countries	17·7	16·2	13·7	12·1	11·0	5·4
Total	100·0	100·0	100·0	100·0	100·0	100·0

Only negligible quantities of canned pineapple had been received from Australia for some years, but there was a revival in 1932, when 10,300 cwts. were imported from that country. Small consignments have also been received from Fiji (1,670 cwts. in 1932, and 870 cwts. in 1931) while a new feature in 1932 was an importation from Mauritius amounting to 500 cwts. From Hayti only 40 cwts. were imported against 1,820 cwts. in 1931. The small imports credited to Japan, which totalled 1,760 cwts. in 1932 as compared with 80 cwts. in 1931 were probably of Formosan origin. The industry in Fiji, Mauritius and Hayti is as yet only on a small scale, but in Formosa it is considerable and growing fairly rapidly.

Seasonal fluctuations of imports of Malayan canned pineapple are fairly well defined. In the first three or four months of the year shipments remain comparatively steady and arrive on a fairly substantial scale, reflecting the winter pack in November and December. May is normally a month of lower imports, but, following the main packing season, a substantial advance occurs in June and the peak of the imports generally occurs in this month or in July. Imports in August and September continue on a considerable but decreasing scale until the month of minimum imports is reached in November.

The small imports from South Africa are, as a rule, fairly evenly distributed over the year. The seasonal change is not very well defined, but, as would be expected, the peak of the shipments generally occurs in the spring. Imports of Hawaiian pineapple reach a peak, though not always their maximum, in February. In the following months a sharp decline is recorded until the lowest point is reached between June and August. The pronounced upward trend normally starts in September, or in October, and is followed by a decline towards the end of the year.

In the foregoing analysis an attempt has been made to explain the normal tendency, departures from which, in some respects, may be noted in the following table in which are set out imports for each month of 1932 from the principal sources of supply.

TABLE III.—*Monthly Imports into the United Kingdom in 1932 of Canned and Bottled Pineapple, preserved in thin syrup.*

Month.	British Malaya.	Union of South Africa.	Other Empire Countries.	United States and Hawaii.	Other Foreign Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	68.7	1.2	—	5.3	—	75.2
February	110.1	0.2	0.1	6.6	—	117.0
March	78.0	0.1	—	4.0	0.2	82.3
April	80.0	0.4	0.9	3.1	0.2	84.6
May	59.6	0.5	2.3	1.1	—	63.5
June	122.2	1.1	1.3	1.0	—	125.6
July	90.9	0.4	0.5	4.7	—	96.5
August	111.7	0.1	0.2	2.1	0.4	114.5
September	63.2	0.2	—	2.4	0.2	66.0
October	57.0	—	1.9	8.7	1.2	68.8
November	32.0	0.1	2.6	7.8	0.3	42.8
December	37.4	0.1	3.7	4.2	—	45.4
Total	910.8	4.4	13.5	51.0	2.5	982.2

IMPORTS OF OTHER CANNED FRUITS

Imports of miscellaneous canned fruits in 1932 shared in the general increase, although the total of 492,000 cwts. was only slightly larger than that of the previous year. The bulk of these imports consists of fruits still unclassified, and these, amounting in 1932 to 424,000 cwts., were supplied almost entirely by foreign countries, chiefly the United States and Italy, although the proportion coming from Empire countries increased appreciably as compared with 1931. Currants and berries also came mainly from foreign countries, but the Empire, principally Canada, was the main source of supply of the small imports of plums.

Detailed figures for 1931 and 1932 are given in Table I.

TABLE I.—Imports into the United Kingdom in 1931 and 1932 of Canned and Bottled Currants and Berries, and Unclassified Fruits, preserved in thin syrup.

Country whence Consigned.	Currants and Berries.		Plums.		Other Sorts.	
	1931.	1932.	1931.	1932.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Australia	3,292	4,036	201	995	278	4,954
Canada	2,885	5,319	4,122	5,349	539	7,098
South Africa	—	247	—	—	1,650	544
Other Empire countries	26	—	5	1	429	1,672
Belgium	1,016	1,396	223	119	206	2,135
France	1,141	1,162	194	111	613	1,256
Italy	21	725	1	1	49,124	55,817
Netherlands	1,788	4,393	26	10	783	490
Russia	—	—	—	—	1,510	38
Spain	—	—	—	—	637	971
Switzerland	1,361	1,708	235	321	185	1,007
Porto Rico	—	93	—	—	2,887	2,060
United States	58,109	40,457	2,653	901	345,917	338,242
Other Foreign countries	13	133	77	17	(a)2,160	(b)7,973
Total Empire countries	6,203	9,602	4,328	6,345	2,896	14,268
Total Foreign countries	63,449	50,067	3,409	1,480	404,022	409,989
Total	69,652	59,669	7,737	7,825	406,918	424,257
Percentage of total from Empire countries	8·9	16·1	55·9	81·1	0·7	3·4
Percentage of total from Foreign countries	91·1	83·9	44·1	18·9	99·3	96·6
Percentage of total imports of canned fruit of all kinds	2·4	1·9	0·3	0·2	13·8	13·2

(a) Includes Greece, 659 cwts. and Japan, 1,228 cwts.

(b) Includes Greece, 2,224 cwts. and Japan, 4,511 cwts.

With the exception of plums, which present no difficulties, the separate classifications into which the miscellaneous fruits are now divided include the imports of a number of different fruits. The

proportions of the total of each group represented by the individual fruits cannot be stated with exactitude, but approximate proportions can be arrived at by reference to the export figures of the different countries concerned, and by an examination of the figures of monthly imports, which indicate the main sources of supply; assistance can also be obtained from the record of weekly arrivals obtained from the analysis of the Customs Bills of Entry, maintained in connection with the Board's weekly supplement to "Canned Fruit Notes." In the analysis attempted in the following paragraphs these methods have been employed, but it must be emphasised that the results obtained are necessarily very approximate.

Currants and Berries

Imports of currants and berries in 1932 showed a substantial decline, owing mainly to the greatly reduced entries from the United States. The quantities received from Empire countries as a whole, represented by Canada, Australia and South Africa, increased by over 50 per cent., raising the share of the Empire in the total from 9 to 16 per cent.

In spite of the reduction in imports from the United States that country remained the principal source of supply. Between 90 and 95 per cent. of the total consisted of loganberries, with small quantities of blackberries, blueberries, strawberries and raspberries. The bulk of the imports from Canada also consisted of loganberries, with blueberries, blackberries, raspberries and strawberries included in the small balance remaining. About half the imports from Australia were blackcurrants, and most of the remainder loganberries and gooseberries.

Of the balance received from other countries raspberries, strawberries and currants formed the bulk of the contribution from the Netherlands, and it is probable that strawberries and blackcurrants accounted for most of the imports from France. Imports from Belgium included gooseberries and currants, while strawberries and raspberries probably accounted for the greater part of the total received from Switzerland.

From the foregoing analysis it may be estimated that loganberries accounted for from 41,000 to 43,000 cwts., which represents a substantial decline on the estimate for the previous year. Of the balance of 16,000 cwts. nearly half appears to have been raspberries

and strawberries, while currants and blackberries formed the bulk of the remainder, gooseberries and blueberries accounting for only a small proportion.

The heaviest shipments of currants and berries arrive in the second half of the year, especially in the months of August to November or December. Imports from the United States, which form such a high proportion of the total, are mainly responsible, and the heavy imports during this period reflect shipments of new season's fruit from that country. The movement is illustrated in Table II, which shows monthly imports in 1932 from the principal countries of supply.

TABLE II.—*Monthly Imports into the United Kingdom in 1932 of Canned and Bottled Currants and Berries, preserved in thin syrup.*

Month.	Australia.	Canada.	United States.	Netherlands.	France and Belgium.	Switzerland.	Total from all sources.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
January ..	—	129	1,043	—	—	—	1,202
February ..	—	759	2,225	70	93	—	3,187
March ..	2,108	27	1,562	17	—	—	3,714
April ..	1,111	35	2,342	1	10	54	3,755
May ..	20	—	3,298	—	125	—	3,471
June ..	526	14	3,660	16	221	83	4,520
July ..	203	38	1,918	525	139	268	3,603
August ..	—	—	6,071	526	303	321	7,279
September ..	—	1,173	6,855	1,235	703	706	10,725
October ..	68	1,179	7,816	129	347	267	9,875
November ..	—	1,938	3,098	1,786	129	—	7,157
December ..	—	27	569	88	488	9	1,181
Total ..	4,036	5,319	40,457	4,393	2,558	1,708	59,669

Plums

Imports of plums in 1932 were slightly larger than in the previous year, and Canada, with an increased quantity, was again the most important source of supply, the contribution from the Dominion amounting to nearly 70 per cent. of the total.

A greatly increased total was received in 1932 from Australia, and that country became next in importance as a source of supply, displacing the United States.

Details of monthly imports are given in Table III.

TABLE III.—*Monthly Imports into the United Kingdom in 1932 of Canned Plums, preserved in thin syrup.*

Month.	Canada.	United States.	Other Countries.	Total.
	Cwts.	Cwts.	Cwts.	Cwts.
January	536	34	—	570
February	275	12	5	292
March	174	8	—	182
April	—	—	402(a)	402
May	987	100	593(a)	1,680
June	—	10	43	53
July	—	5	64	69
August	16	24	22	62
September	—	1	186	187
October	174	65	193	432
November	85	329	22	436
December	3,102	313	45	3,460
Total	5,349	901	1,575	7,825

(a) Australia.

Other Sorts

There was a slight increase in 1932 in the imports of unclassified varieties, the total rising by about 17,000 cwts. to 424,000 cwts. The Empire share in the total increased from 0·7 per cent. to 3·4 per cent. over the year, owing mainly to larger supplies from Australia and Canada. The United States remained the most important source of supply with a slightly decreased total. Italy, supplies from which showed an appreciable advance, was again second in importance.

Normally, over 80 per cent. of the imports from the United States in this class consist of fruit salad, while grapefruit makes up the bulk of the remainder. In 1932 it is probable that as much as

270-275,000 cwts. of the total import of 338,000 cwts. from that source consisted of fruit salad, as compared with about 274,000 cwts. in the previous year, while grapefruit may be estimated at around 50,000 cwts. The principal items in the balance remaining were apparently figs and cherries with small quantities of raisins, grapes and rhubarb.

Imports from Italy, totalling 56,000 cwts., consisted, except for a negligible quantity of grapes, of cherries, as did also imports from France, the Netherlands, Belgium, Switzerland and Russia. Grapes and figs accounted mainly for the small quantities received from Spain, and grapefruit for imports from Porto Rico. The most important items included in "other foreign countries," were 4,500 cwts. from Japan (canned oranges) and 2,200 cwts. from Greece (probably figs and grapes).

Canada was the chief Empire source and the total of 7,100 cwts. appears to have consisted largely of canned cherries and re-exported grapefruit. Small quantities of grapefruit, fruit salad, cherries and passion fruit made up the Australian total, while South Africa's contribution consisted mainly of grapefruit with fruit salad, figs, guavas and quinces. The principal item in imports from "other Empire countries" was 1,400 cwts. from British Malaya, to which there is no clue. The total also included small quantities from Jamaica and other British West Indian islands, and it is probable that these consisted principally of canned grapefruit (from Jamaica) and such fruits as guavas and paw-paws.

Any attempt to summarise figures even for the more important fruits must necessarily yield only approximate results, but it is believed that the following are fairly accurate: fruit salad, 270-275,000 cwts., or about 8.5 per cent. of total imports of fruit preserved in syrup; grapefruit, 50-53,000 cwts. or about 1.5 per cent.; cherries, 60-63,000 cwts. or nearly 2 per cent. There is little doubt that, of the balance remaining, figs and oranges were the largest items, figs probably amounting to between 6,000 and 7,000 cwts. and oranges to between 4,000 and 5,000 cwts.

Shipments are fairly evenly distributed throughout the year as Table IV shows. The explanation lies in the fact that the influence of imports of the three major sorts is felt at different periods of the year, which tends to reduce monthly fluctuations. Shipments of grapefruit are heaviest in the early part of the year, and cherries

from the Continent arrive in greatest quantity in the summer months, while fruit salad from the United States, though shipped in considerable quantities all through the year, reaches its maximum in the last three or four months.

TABLE IV.—*Monthly Imports into the United Kingdom in 1932 of "Other Sorts" of Canned and Bottled Fruits, preserved in thin syrup.*

Month.	Canada.	Australia.	Other Empire Countries.	United States.	Italy.	Other Foreign Countries.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January ..	0.1	—	0.1	18.0	2.1	0.7	21.0
February ..	0.9	—	—	22.4	5.4	1.4	30.1
March ..	—	—	—	28.3	—	1.1	29.4
April ..	—	—	0.1	24.8	0.7	0.5	26.1
May ..	1.0	—	0.1	22.1	—	1.5	24.7
June ..	0.2	3.3	—	17.2	2.4	1.7	24.8
July ..	0.1	0.5	0.1	35.5	12.7	1.5	50.4
August ..	0.1	—	0.1	20.8	14.7	1.4	37.1
September ..	0.4	0.2	1.6	28.3	6.9	0.9	38.3
October ..	2.4	0.2	—	83.3	4.8	2.8	93.5
November ..	1.3	0.4	—	29.0	3.6	2.1	36.4
December ..	0.6	0.3	0.1	8.5	2.5	0.5	12.5
Total ..	7.1	4.9	2.2	338.2	55.8	16.1	424.3

IMPORTS OF FRUIT PULP

Except for the small quantities of fruit pulp "preserved in syrup" (amounting to only 4,944 cwts. in 1931), fruit pulp is not separately distinguished in the Trade Returns of the United Kingdom, and the large consignments of pulp annually imported are included, together with fruit in other forms, under the heading "Fruit preserved without sugar," which is further sub-divided into "Canned or Bottled" and "Other than Canned or Bottled."

It is not possible to determine with precision how much of the fruit included in these categories consists of fruit pulp, and how much of fruit in other forms, nor can the proportion of the different varieties of fruit be obtained with any exactitude, although certain varieties are now separately enumerated. But an examination of the trade returns of the exporting countries, of the seasons of the year when shipments are made and of other records, together with a knowledge of the varieties of fruit grown in the particular countries concerned, afford some guidance as to the quantities and varieties of fruit involved.

Imports of fruit, preserved without sugar, canned or bottled, during the past six years, and the principal consigning countries are given in Table I; and similar imports, other than canned or bottled, in Table V.

TABLE I.—*Imports of Fruit, preserved without sugar (Canned or Bottled).*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Canada	4.9	5.3	3.3	3.2	16.7	25.1
Australia	8.4	20.5	13.7	8.2	1.1	15.2
Other Empire countries ..	1.3	1.4	3.7	3.1	1.5	3.6
United States	130.6	150.4	217.3	132.4	153.0	158.6
Spain	125.3	93.0	130.7	119.0	131.8	146.3
Netherlands	24.0	14.6	13.6	13.7	17.3	8.1
France	16.8	16.3	20.0	13.1	11.1	13.6
Belgium	4.1	5.7	7.7	8.1	7.2	2.4
Italy	2.1	1.9	6.0	5.6	1.5	2.5
Other Foreign countries..	6.2	4.7	15.1 (a)	17.4 (b)	16.2 (c)	9.7 (d)
Total Empire countries	14.6	27.2	20.7	14.5	19.3	43.9
Total Foreign countries	309.1	286.6	410.4	309.3	338.1	341.2
Total	323.7	313.8	431.1	323.8	357.4	385.1

(a) Including Russia, 8.5; Germany, 4.0.

(b) Including Russia, 10.6; Austria, 2.8; Germany, 1.6.

(c) Including Russia, 12.9.

(d) Including Russia, 6.0.

Imports of canned and bottled fruit, preserved without sugar, in 1932 registered a considerable advance on the 1931 total, and at 385,000 cwts., were substantially above the average of 350,000 cwts. for the previous five years.

The share of Empire countries in the total showed a substantial increase in 1932, and amounted to 11 per cent. as compared with about 5 per cent. only in each of the previous three years. Canada was the chief Empire source in 1932 ; imports from that Dominion have risen sharply in the past two years and totalled 25,000 cwts. in 1932 as compared with 17,000 cwts. in 1931. Shipments from Canada consist in the main of canned apples, and small quantities of soft fruit pulp. After showing a rapidly declining trend for several years, imports from Australia rose sharply in 1932 to 15,000 cwts., which compared with only 1,000 cwts. in 1931. The greater part of the fruit shipped from Australia is raspberry pulp. Imports from the Straits Settlements, which probably consist of crushed pineapple, and from South Africa, which are mainly soft fruit pulp, comprise most of the remainder of the Empire supplies.

About 89 per cent. of the canned and bottled fruits preserved without sugar were imported from foreign countries in 1932, the most important being the United States and Spain, which between them contributed nearly 80 per cent. of the total. Imports from the United States, which consist mainly of canned apples, were slightly larger than in the previous year, and consignments from Spain which are chiefly apricot pulp, were appreciably greater, although the increase in 1932 was in imports of other kinds of fruit. Among countries of lesser importance, imports from the Netherlands, Belgium and Russia declined, but those from France increased ; these supplies consist largely of soft fruit pulp.

For 1930, 1931 and 1932 particulars of imports of fruit preserved without sugar, canned or bottled, have been sub-divided into two classes, namely, "Apricots and Apricot Pulp" and "Other sorts." Details of the countries of consignment for these two classes in 1930, 1931 and 1932 are given in Table II. The table shows that about one-third of the imports detailed in Table I consist of apricots and apricot pulp, and that the bulk of the imports of the canned and bottled fruit of this type from Spain are apricots and apricot pulp. It is noticeable, however, that imports from Spain of fruit

other than apricot pulp, registered a sharp increase in 1932. Apricot pulp is not of material importance in the imports from any country except Spain.

TABLE II.—*Imports of Canned or Bottled Fruit, preserved without sugar, in 1930, 1931 and 1932.*

Country whence consigned.	1930.	1931.	1932.
<i>Apricots and apricot pulp.</i>	Thousand cwts.	Thousand cwts.	Thousand cwts.
Spain	111.4	125.9	121.3
Russia .. .. .	.2	3.4	—
United States	2.3	1.8	.6
Italy	1.9	1.4	.3
Belgium .. .. .	.2	1.0	—
Austria	2.8	—	—
Other countries	1.9	1.0	2.7
Total	120.7	134.5	124.9
<i>Other sorts.</i>			
Canada	3.2	16.6	25.1
Australia	8.1	1.1	15.2
Straits Settlements	1.5	.9	1.5
Other Empire countries	1.2	.5	2.1
United States	130.2	151.2	158.0
Netherlands	13.6	17.1	8.1
France	12.5	11.0	13.6
Russia	10.4	9.5	6.0
Belgium	7.9	6.2	2.4
Spain	7.7	5.9	25.0
Italy	3.7	.1	2.2
Other Foreign countries	3.1	2.7	1.0
Total	203.1	222.8	260.2

Apricots and apricot pulp, preserved without sugar, are imported throughout the year, but the largest quantities are recorded in the months of July to October, immediately after the Spanish apricot harvest. Thus in 1931, over one-half, and in 1932 over three-quarters

of the imports were recorded in those four months. Moreover, the months of July and August alone accounted for one-third of the total in 1931, and over one-half in 1932. The figures are shown in Table III.

TABLE III.—*Monthly Imports of Apricots and Apricot Pulp, preserved without sugar (Canned or Bottled).*

Month.	1931.			1932.		
	Spain.	Other Countries.	Total.	Spain.	Other Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
January	5.5	0.8	6.3	0.9	—	0.9
February	1.8	0.1	1.9	5.2	0.4	5.6
March	6.2	0.1	6.3	3.5	1.0	4.5
April	7.3	0.1	7.4	0.9	0.4	1.3
May	12.1	0.5	12.6	0.8	0.6	1.4
June	9.6	0.4	10.0	3.2	0.2	3.4
July	19.8	0.9	20.7	26.3	—	26.3
August	20.9	1.4	22.3	38.1	0.4	38.5
September	7.1	1.2	8.3	17.8	—	17.8
October	16.8	1.2	18.0	13.5	0.5	14.0
November.. ..	10.3	1.2	11.5	9.1	—	9.1
December	8.5	0.7	9.2	2.0	0.1	2.1
Total	125.9	8.6	134.5	121.3	3.6	124.9

The main seasons of imports of canned fruit (without sugar), other than apricots, indicate to some extent the variety of the fruit. Imports from Canada and the United States, consisting largely of canned apples, are at their heaviest after the apple harvest is finished, from November or December to April or May. On the other hand imports from the Continent, consisting mainly of soft fruit pulp, are heaviest in the late summer and autumn, although these, like the supplies from the United States, are spread throughout the year. Table IV shows the seasonal trend of imports during the past two years.

TABLE IV.—*Monthly Imports of Fruit, preserved without sugar, other than Apricots and Apricot Pulp (Canned or Bottled).*

Month.	Canada.	Other Empire Countries.	United States.	France.	Netherlands.	Russia.	Other Foreign Countries.	Total.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
1931.								
January	1.1	—	20.6	1.3	1.0	1.6	0.8	26.4
February	0.9	0.5	11.8	0.4	2.1	—	1.0	16.7
March	0.5	0.6	7.8	0.2	1.1	4.4	0.9	15.5
April	0.6	0.2	13.8	0.6	0.3	1.0	0.9	17.4
May	2.0	0.1	7.0	0.6	0.6	—	0.6	10.9
June	1.0	0.1	11.7	0.5	0.3	—	1.1	14.7
July	0.7	0.3	15.9	0.7	1.8	0.5	1.4	21.3
August	0.5	0.1	8.7	1.7	0.8	—	1.3	13.1
September	0.3	0.2	4.3	1.2	1.5	2.0	1.1	10.6
October	0.1	0.1	3.4	2.7	3.3	—	1.4	11.0
November	4.9	0.3	7.9	0.8	3.0	—	2.7	19.6
December	4.0	—	38.3	0.3	1.3	—	1.7	45.6
Total	16.6	2.5	151.2	11.0	17.1	9.5	14.9	222.8
1932.								
January	1.7	0.7	16.9	0.1	—	3.7	1.3	24.4
February	0.8	0.8	10.8	0.2	1.4	0.9	1.9	16.8
March	2.4	2.9	10.0	0.2	0.9	—	2.6	19.0
April	0.5	3.8	19.7	0.1	1.0	0.9	1.1	27.1
May	1.1	3.9	9.4	0.1	0.1	—	0.9	15.5
June	0.2	2.1	6.9	0.1	0.9	—	1.1	11.3
July	0.5	1.9	4.7	0.8	1.3	—	10.2	19.4
August	0.1	0.7	4.2	4.3	1.2	—	0.9	11.4
September	—	0.7	2.8	4.8	0.5	—	3.8	12.6
October	0.3	0.4	10.8	1.8	0.2	—	3.0	16.5
November	7.4	0.7	17.7	0.7	0.3	0.3	1.6	28.7
December	10.1	0.2	44.3	0.4	0.3	0.3	1.9	57.5
Total	25.1	18.8	158.2	13.6	8.1	6.1	30.3	260.2

Imports of fruit, preserved without sugar, not canned or bottled, from the chief consigning countries during the last six years, are shown in Table V.

TABLE V.—Imports of Fruit preserved without sugar (not Canned or Bottled).

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
India	1.1	4.1	3.8	3.8	4.6	4.4
Australia	2.8	3.1	1.1	—	0.2	3.0
Other Empire Countries..	1.5	1.4	2.1	3.3	2.3	6.2
Netherlands	283.6	385.8	244.7	240.6	412.1	312.8
Italy	216.5	215.5	235.1	220.0	167.9	204.1
Russia	—	1.2	44.8	34.7	55.1	4.5
Spain	46.0	24.8	22.5	27.1	20.1	35.7
France	24.1	16.8	20.8	18.9	19.3	51.5
Crete	5.7	3.6	3.4	6.0	3.4	3.0
Greece	4.0	1.4	3.2	3.9	2.6	3.4
United States	6.0	11.6	5.7	0.5	1.1	3.1
Other Foreign Countries..	10.8	24.0	18.8	13.4	17.8	7.9
Total Empire Countries	5.4	8.6	7.0	7.1	7.1	13.6
Total Foreign Countries	596.7	684.7	599.0	565.1	699.4	626.0
Total	602.1	693.3	606.0	572.2	706.2	639.6

Following the high total of 706,000 cwts. in 1931, there was a decline in imports of fruit, not canned or bottled, in 1932 to 640,000 cwts., which was slightly more than the average of 636,000 cwts. for the previous five years. Supplies were maintained at this relatively high figure in spite of a reduction of nearly 100,000 cwts. in shipments from the Netherlands. Partial compensation for this decline was, however, found in increased consignments from Italy, the low 1931 total of 168,000 cwts. rising to the more normal figure of 204,000 cwts. in 1932. Over 80 per cent. of the total imports (not canned) thus came from two countries, the Netherlands and Italy. Empire countries contributed 2 per cent. only of the total. Shipments from Australia (mostly black currants) increased sharply while supplies from Canada rose from 696 cwts. in 1931 to 3,680 cwts. in 1932.

In Table VI imports of certain classes of fruit, not canned or bottled, which are included in Table V, have been further classified for the year 1932, but as separate figures are available only for that year, comparable figures for previous years cannot be given.

TABLE VI.—*Imports of Strawberries, Black Currants and Unclassified Fruits, preserved without sugar, other than Canned or Bottled, in 1932.*

Country whence consigned.	Straw-berries.	Black Currants.	Other Sorts.	Total.
	Cwts.	Cwts.	Cwts.	Cwts.
Australia	—	2,015	985	3,000
Irish Free State	—	—	1,577	1,577
British India	—	—	4,397	4,397
Canada	—	—	3,680	3,680
Union of South Africa	—	—	746	746
Other Empire Countries	—	—	245	245
Belgium	477	2,762	2,634	5,873
Crete	—	—	2,979	2,979
Greece	—	—	3,358	3,358
Germany	937	605	124	1,666
Netherlands	160,322	35,125	117,400	312,847
Italy	110	—	203,973	204,083
France	3,813	31,323	16,337	51,473
Russia	—	2,743	1,720	4,463
Spain	100	25	35,551	35,676
United States	—	38	3,017	3,055
Other Foreign Countries	60	15	394	469
Total	165,819	74,651	399,117	639,587

Imports from Italy, Spain, Crete and Greece consist mainly of citrus products—orange and lemon peel in brine from Italy, orange pulp from Spain and citron peel in brine from Greece and Crete—although some soft fruit pulp is also included. The imports from Italy, Spain and Greece in 1932 were much greater than in the previous year, but those from Crete declined.

The imports from the remaining countries consist mainly of fruit pulp. Holland, which is by far the most important supplier, is dealt with in the next paragraph. Following substantial supplies in each of the previous three years, imports from Russia in 1932 fell to the small total of 4,500 cwts. comparing with 55,000 cwts. in 1931; more than half of the 1932 total consisted of black currant pulp. Other countries supplying soft fruit pulp were France, Belgium and Germany, and of these the two latter countries showed a decline in shipments. Supplies from France, however, advanced sharply from some 20,000 cwts. in each of the previous five years to 51,000 cwts. in 1932. Over 60 per cent. of the consignments from France in 1932 were black currants.

The Netherlands accounts for about 80 per cent. of the imports other than those believed to be citrus fruit products, and out of a total of 313,000 cwts. imported in 1932 from that country, 160,000 cwts. were recorded as strawberries, 35,000 cwts. as black currants and 117,000 cwts. as other sorts. An examination of the Dutch export returns shows that these "other sorts" consist mainly of raspberry pulp and gooseberry pulp with smaller quantities of plum and red currant pulp. But there are disparities in the figures, which suggest that the United Kingdom provisional figures for "other sorts" may include some strawberry and black currant pulp. If the Netherlands trade returns are accurate the United Kingdom imports of strawberry and black currant pulp are understated by 20 to 25 per cent.

Particulars of recorded exports to the United Kingdom from Holland of both fruit and fruit pulp in the past six years are shown in Table VII. The figures are gross weights, and thus overstate the exports by about 10 per cent.

About 60 per cent. of the exports of pulp from Holland to the United Kingdom in 1932 consisted of strawberry pulp, this being much the same proportion as in the previous two years, but appreciably higher than in other years. Though substantially lower than the very high total for 1931, the volume of shipments of strawberry pulp was much greater than in other recent years. Exports of black currant pulp and gooseberry pulp declined sharply and exports of plum pulp were the lowest since 1926, but raspberry pulp increased slightly.

TABLE VII.—*Exports of Fruit and Fruit Pulp from the Netherlands to the United Kingdom.*

Raw Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apples	28·3	2·0	37·6	1·2	71·5	(a)
Pears	19·7	21·3	19·3	6·6	11·8	8·5
Cherries	4·5	5·3	13·4	6·7	4·5	2·2
Plums	12·7	11·2	12·3	1·7	6·9	7·3
Black Currants ..	17·1	7·9	11·5	20·0	20·2	3·1
Red Currants ..	8·4	9·8	8·8	9·7	8·4	(a)
Gooseberries ..	38·5	15·5	9·6	21·5	12·6	9·3
Strawberries ..	29·3	23·9	22·2	34·6	35·8	24·6
Raspberries ..	0·1	—	—	—	—	(a)
Fruit Pulp.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apple	5·8	1·9	1·8	—	—	—
Pear	—	—	—	—	—	—
Cherry	0·4	0·7	0·7	—	—	—
Plum	22·4	27·6	26·9	22·9	13·9	11·8
Black Currant ..	50·4	45·3	61·4	44·2	85·0	49·4
Red Currant ..	2·8	3·9	3·6	(a)	(a)	(a)
Gooseberry ..	39·0	35·5	25·7	24·7	38·6	26·3
Strawberry ..	151·2	171·1	132·6	151·6	274·2	225·3
Raspberry ..	61·4	41·8	34·6	28·0	48·0	53·2

(a) Figures not available.

The seasons of maximum imports of fruit, preserved without sugar, not canned, are very clearly shown in Tables VIII and IX, which give separate particulars of the monthly imports of strawberries, black currants, and "other sorts" for the year 1932. These fruits

came almost entirely from European countries, and, as would be expected, the bulk of the shipments are made in the summer months. Imports from Holland are heaviest during July and August following the harvest of the soft fruits, while imports from Italy are heaviest during the first six months of the year and thus reflect the citrus fruit season. Imports from Spain also are normally greater in the first half of the year, but exceptionally large consignments were received in the second part of 1932. August and September are the most important months in the year for arrivals of French fruit and about half the annual imports are received in this period.

TABLE VIII.—*Monthly Imports of Strawberries and Black Currants preserved without sugar (not Canned or Bottled) in 1932.*

Month.	Strawberries.				Black Currants.			
	Nether-lands.	France.	Other Countries.	Total.	Nether-lands.	France.	Other Countries.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January ..	3.4	—	—	3.4	1.0	0.1	0.3	1.4
February	6.1	0.1	0.3	6.5	2.5	—	1.0	3.5
March ..	0.9	—	0.6	1.5	0.1	—	0.1	0.2
April ..	10.6	—	—	10.6	0.2	0.1	0.4	0.7
May ..	0.5	0.2	—	0.7	0.2	—	0.5	0.7
June ..	10.1	1.8	—	11.9	0.3	0.2	—	0.5
July ..	83.4	0.6	0.6	84.6	7.6	3.6	0.8	12.0
August	18.4	1.1	—	19.5	8.7	14.6	1.1	24.4
September	7.8	—	—	7.8	5.4	10.0	0.3	15.7
October ..	7.3	—	—	7.3	5.9	2.4	1.3	9.6
November	3.9	—	0.2	4.1	1.3	0.1	2.5	3.9
December	7.9	—	—	7.9	1.9	0.2	—	2.1
Total	160.3	3.8	1.7	165.8	35.1	31.3	8.3	74.7

TABLE IX.—*Monthly Imports of Fruit, other than Strawberries and Black Currants, preserved without sugar (not Canned or Bottled) in 1932.*

(thousand cwts.)

Month.	Italy.	Nether-lands.	Spain.	France.	Other Countries.	Total.
January	1·8	7·4	0·5	0·6	2·5	12·8
February	20·9	16·4	3·1	1·0	2·4	43·8
March	34·8	2·4	2·1	0·1	1·6	41·0
April	45·2	8·2	1·2	0·5	2·3	57·4
May	30·7	0·1	4·4	0·1	1·0	36·3
June	32·0	3·7	0·7	0·3	1·9	38·6
July	9·9	26·6	5·4	6·7	2·3	50·9
August	3·7	17·0	6·2	2·4	2·3	31·6
September	5·4	16·0	6·6	1·8	3·1	32·9
October	7·6	8·2	1·2	1·3	1·2	19·5
November	3·6	6·2	3·2	1·0	1·9	15·9
December	8·4	5·2	1·0	0·5	3·3	18·4
Total	204·0	117·4	35·6	16·3	25·8	399·1

The value of imports of fruit, preserved without sugar, in the past three years is given in Table X.

TABLE X.—*Value of Imports of Fruit, preserved without sugar.*

<i>Fruit.</i>	1930	1931	1932
Canned or Bottled—			
Apricots and Apricot Pulp	£ 114,132	£ 117,951	£ 107,036
Other Sorts	310,751	297,455	374,687
Other than Canned or Bottled—			
Strawberries	} 688,031	} 690,490	212,787
Black Currants			135,399
Other Sorts			378,802
Total	1,112,914	1,105,896	1,208,711

Average declared values in the years 1930 to 1932 are shown in Table XI. The most striking feature of the table is the relatively small fall in average values over a period when there was a heavy decrease in general wholesale prices. In fact, the average values of the canned and bottled varieties, other than apricots, and of the non-canned sorts actually showed an increase last year in comparison with 1931, though this may have been partly due to the depreciation of sterling.

For the non-canned varieties greater detail is available for 1932. Black currants were relatively high at 36s. 3*d.* per cwt., as against 25s. 8*d.* per cwt. for strawberries and 19s. 0*d.* per cwt. for the remaining unclassified varieties.

TABLE XI.—Average declared values (per cwt.) of Imports of Fruit preserved without sugar.

<i>Fruit.</i>	1930		1931		1932	
Canned or Bottled—	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
Apricots and Apricot Pulp.	18	11	17	7	17	2
Other Sorts	30	7	26	8	28	10
Other than Canned or Bottled.	24	1	19	7	22	9

IMPORTS OF CANNED VEGETABLES

The United Kingdom trade returns include three categories of vegetables preserved by canning and bottling—tomatoes, peas and other descriptions; peas were not separately distinguished prior to the year 1931. But the totals under these headings are not complete, since canned vegetables to which any sweetening matter has been added are included in the further more comprehensive classification of "Other preparations for use as food made with added sugar or other sweetening matter."

It is possible, however, by referring to the trade returns of certain of the exporting countries to arrive at an indication of the volume of the import trade in some of the more important classes of canned vegetables. But owing to the practice of grouping several kinds

under one heading, and also to the possibility that some canned vegetable preparations, e.g. soups, may be classified as canned vegetables in some countries and not in others, nothing beyond tentative estimates of volumes can be attempted. It must also be remembered that canned products are not always distinguished from products in other containers in the trade returns of certain foreign countries, but it is probable that this factor does not materially affect an analysis based on them since the quantities involved are small.

In the following table are set out imports in 1930 and in 1931 (the last year for which figures are available) of the three categories in which canned vegetables are known to be included in the United Kingdom trade returns:—

Imports in 1930 and 1931 of Canned and Bottled Tomatoes, other Canned and Bottled Vegetables, and other Preparations used as Food.

Country whence consigned.	Vegetables preserved by Canning or Bottling, with no Sweetening Matter.						Other Preparations —with Added Sugar or Other Sweetening Matter.		
	Tomatoes.		Peas.		Other Descriptions.		1930.	1931.	
	1930.	1931.	1930.	1931.	1930.	1931.			
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	
<i>Empire Countries:—</i>									
Canada	4.4	6.0	(a)	.2	0.5	—	0.5	191.3	245.6
Irish Free State..								31.5	34.0
Other Empire ..								1.7	2.6
<i>Foreign Countries:—</i>									
United States ..	13.6	12.6	(a)	—	21.4	16.6	244.4	175.1	
France	49.2	44.4		—	11.8	7.7	3.1	2.4	
Spain	132.1	178.9		—	—	—	—	—	
Italy	433.7	535.9		4.7	11.2	10.2	6.4	2.4	
Netherlands ..	—	—		—	1.7	—	8.7	8.0	
Belgium.. ..	—	—		20.0	62.9	39.8	37.9	52.8	
Other Foreign ..	13.7	22.8	1.8	5.6	4.6	8.2	12.1		
Total—Empire ..	4.4	6.0	(a)	0.2	0.6	0.5	224.5	282.2	
Total—Foreign ..	642.3	794.6	(a)	26.5	114.6	78.9	308.7	252.8	
Total	646.7	800.6	(a)	26.7	115.2	79.4	533.2	535.0	
		(b)		(b)		(b)			

(a) Included in "Other Descriptions."

(b) Excluding bottled vegetables of all descriptions totalling 600 cwts.

The analysis in the following paragraphs is devoted mainly to an attempt to separate canned vegetables from the imports of "Other preparations" shown in column 8 of the table.

Canada.—Imports of canned tomatoes, canned peas and other canned vegetables recorded as coming from Canada are included in the composite totals entered from Empire countries under these headings, and probably comprise the bulk of each classification. The Canadian trade returns, however, show that during 1931 over 53,000 cwts. of canned tomatoes, nearly 32,000 cwts. of beans and 5,600 cwts. of miscellaneous varieties were exported to this country, and it is evident that the bulk of these categories is included in the last column of the table.

Of the 32,000 cwts. of beans exported the bulk no doubt consisted of baked beans, and canned corn and peas probably formed the greater part of the 5,600 cwts. of other canned vegetables, though small quantities of such vegetables as asparagus and spinach may also have been included.

United States.—Imports of canned tomatoes in 1931 amounted, according to the United Kingdom Trade Returns, to about 13,000 cwts.; no imports of peas were recorded and other descriptions totalled nearly 17,000 cwts. But recorded exports from the United States amounted to 8,970 cwts. of canned tomatoes and 77,690 cwts. of other canned vegetables. A similar discrepancy may be noted in comparing the figures for tomatoes for the previous year, and as in some years agreement is fairly close the difference is not easily accounted for, though it may be that the import of 13,000 cwts. includes some tomato product, such as canned tomato soup, which is omitted from the United States returns. Some part of the difference may also be due to the inclusion in the United Kingdom import returns of Canadian canned tomatoes consigned through United States ports, and not identified as such on reaching this country.

It is clear, however, that a large proportion of the other sorts of canned vegetables is entered under the heading "Other preparations etc.," shown in the table. Included in the 77,690 cwts. of canned vegetables, other than tomatoes, exported from the United States to this country in 1931 were 47,800 cwts. of baked beans and beans with pork, 13,900 cwts. of asparagus, 7,580 cwts. of peas, 6,440 cwts. of corn and 1,960 cwts. of unclassified canned vegetables. There is

no information as to the composition of the last item, but it may have included string beans, spinach, beets, carrots and macedoine of vegetables.

France.—Exports of canned tomatoes from France in 1931 totalled 49,600 cwts. as compared with recorded imports into this country of 44,400 cwts. The difference is mainly accounted for by the fact that French exports are given in gross weights, and if allowance is made for this factor the figures practically agree.

Of the 12,000 cwts. of canned vegetables other than tomatoes, about 1,500 cwts. consisted of peas, beans and carrots, and it is probable that beans formed the greater part of this total since no imports of peas in brine into this country from France were recorded in 1931. The balance of 10,700 cwts. about (9,600 cwts. net) most probably consisted, in varying proportions, of mushrooms, spinach, macedoine and celery, with smaller quantities of other canned vegetables. It is believed, however, that mushrooms were probably the most important, followed by spinach and macedoine.

Italy.—Exports to this country from Italy in 1931 of canned tomatoes (including other forms of preserved tomatoes), amounted to 485,000 cwts., while imports into the United Kingdom recorded from Italy totalled 536,000 cwts. The discrepancy is probably due to the export to this country of Italian canned tomatoes overland and their inclusion in the Italian trade returns as shipped to one of the Continental countries through which they passed.

It is impossible to identify canned vegetables other than canned tomatoes in the Italian trade returns, but it would appear to be likely that the bulk is included in the class described as beans, peas, and cucumbers, and gherkins in brine or oil. Figures of exports to this country are unfortunately not available for periods later than 1929, but according to the monthly returns, exports to the United Kingdom of fruits and vegetables in vinègar, brine or oil (which in addition to beans, peas, etc., includes olives and a quantity of unspecified fruits and vegetables) totalled about 21,150 cwts. It therefore seems probable that the figure of 15,900 cwts., recorded in the United Kingdom trade returns (4,700 cwts. of peas and 10,200 cwts. of other descriptions) as coming from Italy, represents the bulk of canned vegetables canned or bottled in brine received from that source. It is also fairly certain that the greater part included under the heading "other descriptions" consisted of beans.

Belgium.—Recorded imports of canned peas from Belgium in 1931 amounted to 20,000 cwts. and of “other descriptions” to 39,800 cwts. According to the Belgium trade returns, however, exports of canned peas to this country totalled 61,570 cwts., exports of other canned vegetables amounting to 47,000 cwts. These differences suggest that a certain quantity of both categories (nearly 38,000 cwts. in all when allowance is made for the difference between gross and net weights) contained sugar or other sweetening matter and is included in the last column of the table given at the beginning of this section. No information is available to show the quantities of the different varieties included in the exports of miscellaneous canned vegetables, amounting to about 42,000 cwts. (net), but spinach and macedoine were probably the most important items with smaller quantities of a number of other canned vegetables such as celery, carrots, turnips, parsnips and cabbage.

Summary.—It will be realised from the foregoing analysis that precise estimates cannot be made. It is, however, possible to amplify to a certain extent the details given in the table of imports.

Except for Canada and the United States it is probable that no adjustments need be made in the figure of 800,000 cwts. given in the returns as imports of canned tomatoes in 1931. When these adjustments have been carried out the figure is raised to about 845,000 cwts., the balance of about 45,000 cwts. being recorded in the category “other preparations, etc., with added sugar or other sweetening matter.”

It will be recalled that in several instances, e.g. the United States and Belgium, especially the latter, there was clear evidence that recorded imports of peas were understated, and there is little doubt that the bulk of the imports fall into the third category set out in the table. On the basis of the statistics of exports from the supplying countries imports of canned peas may be estimated at from 68,000 to 70,000 cwts., and it may be noted that this figure shows some increase on the estimate of 60,000 cwts. for the previous year.

Imports of “Other Descriptions” of canned vegetables recorded in the United Kingdom Trade Returns amounted to 79,000 cwts., but if the quantities exported from the principal countries concerned are taken into account the total would appear to be about 180,000 cwts. of which some 100,000 cwts. is entered under “Other Preparations for use as food, etc.” Of the total of 180,000 probably 80,000

cwts. consisted of baked beans, and about 8,000 cwts. of canned corn, while canned asparagus may be tentatively placed at 15,000 cwts., though there is more doubt about this figure.

From the foregoing paragraphs it will be seen that total imports of canned vegetables in 1931 amounted to about 1,097,000 cwts. of which 907,000 cwts. were included in the three categories of imports of "Vegetables preserved by Canning or Bottling, with no Sweetening Matter," and the remainder under "Other Preparations for use as Food, etc."

CANADIAN PRODUCTION AND EXPORTS OF CANNED FRUITS AND VEGETABLES

The Dominion Bureau of Statistics have so far issued only a preliminary report on the canning industry in 1932, and according to these figures the canned fruit pack reached record dimensions, while the output of canned vegetables, which is of relatively greater importance, showed a further substantial decline.

The effect of the generally depressed conditions prevailing during the year is reflected in the number of factories operating. The number of plants included in the Census was 235, a slight increase on the previous year's figure of 220. Of this total 86 were not operating as compared with 58 in 1931, and the number of plants from which reports were received declined from 151 to 141, mainly situated in Ontario (80), Quebec (35) and British Columbia (18). This represents a sharp decline from the 1930 level when the number of factories in operation whose main business was fruit and vegetable canning was 188. During the past three years average output per unit of canned fruits and vegetables appears to have declined substantially, while the total has decreased from about 9,700,000 cases in 1930 to some 5,300,000 cases in 1932.

I.—CANNED FRUITS

Production

According to the preliminary figures the production of canned fruits in 1932 totalled over 1¼ million cases, thus exceeding the high 1929 level by 170,000 cases. With the exception of raspberries, strawberries and the unclassified small fruits all lines showed considerable increases over the previous year, peaches and pears reaching

record high levels. The greatest increase occurred in the pack of apples which, though still far below the 1929 figure, was over three times as large as in 1931, while the pear output was more than doubled.

Table I shows the output of the various fruits in 1932, with comparative figures for the previous five years. It is estimated that the 1932 figures given in this table and in Table IV, which are preliminary, comprise about 95 per cent. of the total production.

TABLE I.—*Canadian Canned Fruit Packs.*

Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.
Apples	108,080	177,282	331,691	19,097	60,895	228,730
Peaches	77,671	128,386	90,755	139,200	205,148	248,934
Pears	145,193	310,525	237,384	299,800	161,052	374,075
Plums	42,274	141,999	89,375	78,358	64,099	86,550
Cherries	39,361	73,599	95,155	128,055	73,933	114,110
Raspberries ..	56,347	47,529	53,043	40,205	65,463	35,106
Strawberries ..	50,138	40,587	52,758	36,524	29,823	28,210
Blueberries ..	(a)	(a)	(b)	(b)	9,718	18,226
Other small fruits	(a)	(a)	72,743	87,783	49,389	33,092
All other fruits ..	78,258	99,585	78,284	98,816	65,313	105,301
Total	597,322	1,019,492	1,101,188	927,838	784,833	1,272,334

(a) Not separately specified, included in "All other fruits."

(b) Not separately specified, probably included in "Other small fruits."

Canada is a net importer of canned fruits, though this position arises from the large imports of canned pineapples, which are, of course, not produced in the Dominion. In 1926 net imports totalled 162,500 cwts. and in 1930 they were as high as 345,000 cwts. There was a decline in 1931 to 234,000 cwts. and last year net imports fell to only 11,000 cwts.

Apparent consumption in Canada as measured roughly by the sum of the production and net imports declined in 1930 from the high level of the two previous years. There was a further and more marked contraction in 1931 and last year in spite of the record pack there seems to have been a further slight decline.

Exports

Exports of canned fruits from Canada in 1932 showed a pronounced increase to nearly 92,000 cwts., the highest figures attained since 1925. For the five years 1927 to 1931 annual exports averaged about 41,000 cwts. Details are given in Table II.

TABLE II.—*Exports of Canned Fruits from Canada, 1927-1932.*

Fruit and Country to which consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
<i>Pears.</i>						
United Kingdom ..	} (a)	(a) {	35,312	17,026	17,011	39,256
Other Countries ..			630	453	1,332	1,184
Total	(a)	(a)	35,942	17,479	18,343	40,440
<i>Other Canned Fruits.</i>						
United Kingdom ..	42,589	24,020	13,626	7,716	26,843	49,430
United States ..	1,745	32	1,411	2,885	1,204	24
Other Countries ..	3,996	2,519	952	1,280	1,193	1,974
Total	48,330	26,571	15,989	11,881	29,240	51,428
Total Exports ..	48,330	26,571	51,931	29,360	47,583	91,868

(a) Included in "Other Canned Fruits."

Imports

In 1932 imports of canned fruits into Canada shrank to little more than one-third of the previous year's level, all classes of fruit sharing in the decline. Canned pineapples are every year the principal item of import, and accounted for 65 per cent. of the total in 1932, as compared with 68 per cent. in 1931 and 56 per cent. in 1930.

In recent years a considerable change has taken place in the countries of supply, and Australia has now displaced the United States as the most important source. In 1926 and 1927 practically all the imports of canned peaches came from the United States, but from 1928 onwards a larger proportion has been supplied by Australia who, in 1932, supplied 90 per cent. of the total imports of peaches (with which apricots are included in the Canadian returns). In the case of pears the development of the trade with Australia

came later, and it was not until 1931 that imports from that country formed a substantial proportion of the total. In that year they amounted to more than half the total and in 1932 to over two-thirds. Until 1932 pineapples came mainly from British Malaya and Hawaii with smaller quantities from South Africa, the proportion of the Malayan variety in the total tending to grow at the expense of Hawaii. In 1932, however, there was a considerable contraction in imports from Malaya, and although about 50 per cent. of the total for the year were received from that source Australia moved into second place with 37 per cent. The bulk of the comparatively small quantities of unclassified fruits still comes from the United States, with small shipments from the United Kingdom, Australia and European countries.

Total imports of each fruit in the past six years are shown in Table III.

TABLE III.—*Imports of Canned Fruits into Canada, 1927–32.*

Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Peaches.. ..	58,562	94,707	109,333(a)	96,071(a)	57,876(a)	28,528(a)
Pears	7,860	10,299	11,618	11,774	6,892	2,577
Pineapples ..	121,614	185,803	168,927	208,980	191,767	67,357
Other canned fruit	52,692	65,027	71,820	58,318	24,949	4,430
Total ..	240,728	355,836	361,698	375,143	281,484	102,892

(a) Including apricots.

II.—CANNED VEGETABLES

Production

Canned vegetable production in Canada again declined substantially in 1932, the reduction of nearly 33 per cent. on the 1931 figures bringing the total to considerably less than half of the 1930 record and resulting in the lowest output for many years.

All the more important packs suffered considerable decreases in 1932, the most pronounced reduction occurring in the output of canned corn, which amounted to less than one-third of the 1931 total. The decline was relatively smallest for peas, and there was an increase

in the small miscellaneous group which includes asparagus (37,000 cases), spinach (48,000 cases) and pumpkins (48,000 cases) and small quantities of beets and carrots. All these items, with the exception of beets and pumpkins, showed substantial increases over the previous year. The increase was even more marked for tomato juice (not included in Table IV), output of which increased from 177,000 cases in 1931 to 310,000 cases in 1932. Tomato paste and puree were also produced in larger quantities, the pack of 71,000 cases comparing with 56,000 cases in 1931.

Table IV gives preliminary figures of the canned vegetable pack in 1932, together with particulars for the previous five years for the purpose of comparison. As in the case of fruit the revised figures for 1931 given in the table show substantial increases for many items.

TABLE IV.—*Canadian Canned Vegetable Packs.*

Description.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.
Tomatoes	1,563	1,865	1,976	3,389	2,193	1,432
Peas	984	1,033	965	2,554	1,143	1,008
Corn	593	918	893	1,078	1,396	420
Baked beans	1,051	1,246	1,300	1,027	861	732
Green or wax beans ..	131	217	297	349	252	211
Other vegetables	135	206	168	353	134	210
Total	4,457	5,485	5,599	8,750	5,979	4,013

For some years before 1930 Canada was a net importer of canned vegetables. In 1931, although there was a marked decrease in output, the Dominion became a net exporter, and last year, when production was even smaller than in 1931, the excess of exports over imports rose to nearly 134,000 cwts., due to a substantial increase in exports and a pronounced decline in imports, particularly of items such as baked beans, corn, peas and tomatoes, already produced in the country.

It seems clear that declining domestic consumption was responsible for this change. Between 1926 and 1930 a rapid expansion took

place, but in 1931 there was a substantial decline which was continued in 1932, when consumption was probably at no more than half the 1930 level.

Exports

Exports of canned vegetables from Canada rose to a peak in 1929 mainly as the result of greatly increased shipments of canned tomatoes to the United States where the pack was short. In the following year there was a decline to less than half the 1929 total, but exports increased in 1931, and last year saw a further increase to about the 1928 level. Exports of beans in 1932 were only half as heavy as in the preceding year, but tomatoes were doubled and other canned vegetables showed a substantial increase.

Details of exports in the past six years are given in Table V.

TABLE V.—*Exports of Canned Vegetables from Canada, 1927–1932.*

Vegetable and Country to which consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
<i>Beans.</i>						
United Kingdom ..	98,091	128,961	59,148	33,982	31,933	13,253
Other countries ..	2,039	5,411	9,142	10,477	4,085	5,258
Total	100,130	134,372	68,290	44,459	36,018	18,511
<i>Tomatoes.</i>						
United Kingdom ..	822	5,421	174	22,564	53,432	20,024
Other countries ..	1,380	6,760	109,173 ^(a)	6,217	3,839	98,174 ^(b)
Total	2,202	12,181	109,347	28,781	57,271	118,198
<i>Other Canned Vegetables.</i>						
United Kingdom ..	5,662	6,832	5,949	5,184	5,605	7,228
Other countries ..	5,935	14,698	7,416	10,509	10,564	17,108 ^(c)
Total	11,597	21,530	13,365	15,693	16,169	24,336
Total Exports.	113,929	168,083	191,002	88,933	109,458	161,045

^(a) Including 107,068 cwts. to United States.

^(b) Including 94,022 cwts. to United States.

^(c) Including 7,182 cwts. to United States.

Imports

Between 1926 and 1929 imports of canned vegetables into Canada rose from 120,000 cwts. to 206,000 cwts., an increase of more than 70 per cent. shared by all kinds of vegetables except baked beans which declined by about 50 per cent., coincident with a sharp increase in Canadian production. Imports of asparagus and tomatoes were doubled during the period, and those of corn trebled, while the increases for peas and miscellaneous canned vegetables amounted to about 73 and 30 per cent. respectively.

In 1930 there was a considerable increase in the output of Canadian canned vegetables and this was reflected in the substantial reduction in imports. The decline continued in the two following years, although production has sharply contracted and exports have increased; in 1932 imports were not much more than one-eighth of the total in 1929, the peak year.

The United States is the principal source of Canadian imports of canned vegetables. Practically all the asparagus, baked beans and corn come from that country, but mushrooms are chiefly of French origin, and Italy is the chief supplier of tomatoes. Imports of peas came mainly from Belgium in 1932; receipts from the United States were small; and small quantities were imported from the United Kingdom. The United States was the principal source of the imported miscellaneous canned vegetables in 1932, but Spain had a comparatively large share in the total and small quantities were received from Belgium, France and the Netherlands.

TABLE VI.—*Imports of Canned Vegetables into Canada, 1927-1932.*

Vegetable.	1927.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Asparagus	14,775	15,176	18,251	13,030	9,274	7,107
Baked beans	10,858	8,485	12,294	7,797	6,067	1,192
Corn	22,703	39,650	44,409	29,682	9,575	358
Mushrooms	(a)	5,398	7,230	7,399	6,028	3,871
Peas	39,120	36,530	47,970	39,508	18,119	3,610
Tomatoes	13,353	18,250	19,257	14,506	7,427	1,882
Other Canned Vegetables	49,179	46,873	56,886	39,655	18,729	9,494
	149,988	170,362	206,297	151,577	75,219	27,514

(a) Included in "Other Canned Vegetables."

AUSTRALIAN CANNED FRUIT PRODUCTION AND EXPORTS

I.—PRODUCTION

During recent years the production of canned apricots, peaches and pears, which are by far the most important products of the Australian canned fruit industry, has fluctuated from season to season, but until 1931 the tendency was on the whole upward. The pack of apricots and peaches in 1930 constituted a record; apricots, at 277,000 cases, were 11 per cent. above the previous record in 1928, while peaches, which, every year, form the largest proportion of the pack, for the first time passed the million mark, reaching 1,114,000 cases, about 13 per cent. in excess of 1928. The pack of pears was, however, a shade lower than the figure for 1928, which remained the record for that fruit until 1932.

In 1931, output was considerably reduced, partly on account of unfavourable crops, and partly owing to the uncertainty of the market and the existence of unsold stocks. The production of apricots totalled barely one-third of the 1930 pack, peaches fell by 40 per cent., and pears only just exceeded one-quarter of the previous year's output; the 1931 figures for apricots and pears were, in fact, the lowest recorded for ten years.

The total pack of these fruits in 1932 was substantially larger than in the previous year though well below the 1930 record. The output of apricots though double the 1931 production was much below the level of the previous three years; peaches, owing to the small crop, declined further to the low level of 532,000 cases or less than half the 1930 figure; but pears reached the record figure of 440,000 cases.

Production of these fruits (in cases of 24 No. 2½ cans) in the seasons 1926-27 to 1931-32 is shown in Table I.

TABLE I.—*Output of Australian Canned Apricots, Peaches and Pears in the production years 1926-1927 to 1931-1932.*

Fruit.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.
Apricots	174	249	237	277	92	183
Peaches	621	983	663	1,114	684	532
Pears	172	395	286	394	103	440
Total	967	1,627	1,186	1,785	879	1,155

II—EXPORTS

The United Kingdom is by far the most important market, outside Australia, for these fruits and, since the 1927 season, the general tendency has been for a larger quantity to come to this country. The proportion of the yearly output sent here, neglecting considerations of carry-over, also shows an upward trend, especially in the past six years. In the 1928/29 season the proportion of the output of apricots, peaches and pears, shipped to the United Kingdom was 27 per cent., in the following season it rose to 33 per cent., declining in the succeeding year to 29 per cent. In 1931/32, in spite of the small pack, which totalled only about half that of 1930, shipments were maintained at nearly the same level, and the percentage rose to about 60. It is clear, however, that the large carry-over from the previous season's pack played a considerable part in producing this result, which must be regarded as abnormal. In 1932/33 shipments rose to a high level, although there was not much increase on the previous season, but the pack was considerably larger and the percentage fell to 48 per cent., which was, however, much in advance of any of the other above mentioned seasons, except 1931/32.

Of the total shipments, which have amounted to over 500,000 cases in each of the past three seasons, peaches were the most important item until last season, and in 1930/31 and 1931/32 accounted for about 60 per cent. But in 1932/33, owing to the continuation of a light peach pack and a record output of pears, the percentage of peaches fell to 40 per cent., and the premier position was taken by pears, which had previously been next in importance. The increase in shipments of pears in recent years has been very considerable; in 1932/33 they were in excess of a quarter of a million cases, and accounted for no less than 47 per cent. of the total shipments. Apricots have declined appreciably in the past few years and accounted for 13 or 14 per cent. only in the last two seasons as compared with 28 per cent. in 1929/30.

Shipments to the United Kingdom each season are shown in Table II. The figures of shipments for the seasons 1927-28 and 1928-29 have been taken from official Australian sources, but in the absence of comparable figures for subsequent seasons, the details for each fruit have been arrived at by totalling the official advices received by the Board of shipments from Australia during the period March to

February, which is roughly the export season. These figures represent total shipments during this period, and thus include any fruit of earlier season's pack.

TABLE II.—*Shipments to the United Kingdom of Australian Canned Apricots, Peaches and Pears in the months of March to February in the seasons 1927-28 to 1932-33.*

Fruit.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.	1932-33.
	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.
Apricots	(a)	58	110	97	71	71
Peaches	46	286	203	312	319	220
Pears	(b)	88	76	117	127	259
Total	46	432	389	526	517	550

(a) 30 cases only. (b) 37 cases only.

Distribution of Exports of Australian Canned Fruits

The foregoing paragraphs deal only with the production of apricots, peaches and pears, and with the exports of these fruits to this country by seasons. No production figures for fruits other than these are published, and exports by seasons to destinations other than the United Kingdom are not given in official statistics for the individual fruits. The distribution of the exports during the fiscal year, running from July to June, can, however, be obtained from the Commonwealth oversea trade returns, and these figures form the basis of the following.

Table III shows total exports of Australian-produced apricots, peaches, pears, pineapples and miscellaneous canned fruits in the years 1926-27 to 1930-31, the latest period for which returns have been received. The United Kingdom, as already pointed out, is the most important market, and in 1930-31 took 62 per cent. of the apricots, 69 per cent. of the peaches, 89 per cent. of the pears, 31 per cent. of the pineapple, and 61 per cent. of the miscellaneous fruits. Canada and New Zealand are the next in importance and the percentage sent to the former country is increasing. In 1930-31, 12 per cent. of the exports of apricots went to Canada as compared with 7 per cent. the previous year, 17 per cent. of the peaches against 13 per

cent., 7 per cent. of the pears against 4 per cent. and 67 per cent. of the pineapple, while New Zealand took 22 per cent. of the apricots against 24 per cent., 13 per cent. of the peaches against 19 per cent. and 1 per cent. of the pears against 2 per cent. In addition to these main markets, which, in the year ended June, 1931, absorbed over 97 per cent. of the total exports, there is a small trade with islands in the Pacific and also with India and the Union of South Africa.

TABLE III.—*Exports of Australian Canned Fruits from July to June, 1926-27 to 1930-31.*

Fruit.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.
	cwts.	cwts.	cwts.	cwts.	cwts.
Apricots	16,830	31,068	42,916	50,730	41,873
Peaches	62,412	124,376	105,422	170,178	194,852
Pears	6,582	32,337	26,563	49,908	57,599
Pineapples	44	306	49	238	8,207
Other Canned Fruits..	4,691	7,329	11,416	9,660	4,848
Total ..	90,559	195,416	186,366	280,714	307,379

Among the unclassified canned fruits black-currants, loganberries, raspberries and gooseberries are normally the most important, but fair quantities of plums and apples are shipped in some years, and in the last two years small consignments of strawberries were made. According to official advices of shipments, the following quantities were exported to the United Kingdom from Australia in the twelve months ended 28th February this year:—raspberries, 1,000 cases; loganberries, 825 cases; strawberries, 500 cases; black-currants, 5,049 cases; plums and greengages, 3,125 cases; gooseberries, 5,050 cases; golden-berries, 3,025 cases; apples, 5,005 cases; fruit salad, 500 cases; blackberries, 325 cases; grapefruit, 131 cases; with small quantities of golden drops, cherries and passion fruit total-ling 135 cases.

EXPORTS OF MALAYAN CANNED PINEAPPLE

The area under the cultivation of pineapples in British Malaya in 1931 is officially estimated at about 51,250 acres, a decline on the previous year when the figure of 54,300 acres was the highest recorded. In the bulk of this area pineapples are grown as a catch crop with rubber, but it is probable that cultivation as a sole crop will be

extended in the future. Statistics of output of canned pineapple are not available, but as a very large proportion of the production is exported exports form a fair indication of the movement.

In the period 1921 to 1931 annual exports of Malayan canned pineapple averaged nearly 42,000 tons. In 1921, they amounted to 21,000 tons, and by 1925 they had risen to 43,000 tons. This was followed by slight declines in the years 1926 and 1927 with further sharp rises in 1928 and 1929 while last year they reached the record total of 66,300 tons.

The bulk of the exports goes to countries in the British Empire, which take about nine-tenths of the total each year. From 1925 to 1930, there was a tendency for the percentage exported to this country to decrease, but increased shipments to other countries in the Empire (mainly Canada), which nearly trebled in the period, largely offset the decline. During the last two years the United Kingdom's share has sharply increased and in 1932 amounted to 84 per cent. which was greater than in any year since 1925 ; the quantity going to Empire countries, however, fell heavily last year. Shipments to European countries and to the United States and other countries have declined in the past few years.

Exports of canned pineapple from Malaya in the past eight years are shown in the following table, which has been compiled from the official returns of the Malayan Government. It will be noted that the figures of exports to this country given in this table exceed the imports from Malaya shown in Table I on page 27. The discrepancy amounts, in most years, to about 20 per cent. and is probably accounted for mainly by differences between gross and net weights.

Exports of Canned Pineapple from Malaya

Year.	United Kingdom.	Other Empire Countries.	Continent of Europe.	United States.	Other Countries.	Total.
	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.
1925 ..	36.3	3.9	1.2	0.7	1.1	43.2
1926 ..	31.1	6.5	1.1	0.6	1.3	40.6
1927 ..	30.9	6.2	0.9	0.8	1.3	40.1
1928 ..	33.5	8.2	1.6	1.1	2.0	46.4
1929 ..	40.6	10.0	3.8	1.4	2.9	58.7
1930 ..	40.2	10.1	4.0	1.2	2.5	58.0
1931 ..	44.2	10.2	3.0	0.8	1.3	59.5
1932 ..	55.7	5.9	2.9	0.8	1.0	66.3

Malayan canned pineapples are shipped in considerable quantities all the year round, but exports reach their peak from May to July reflecting the main crop season. Thereafter a decline sets in, and September to November are usually months of minimum export. A sharp rise usually occurs in December following the second main crop, but exports in this and the following two months do not normally reach the high level of the early summer months.

CANNED FRUIT PRODUCTION IN THE UNITED STATES

Canned fruit production in California and the Pacific North-West States comprises a large proportion of the total output in the United States, and is especially important from the point of view of the United Kingdom market. Up to 1928, the year of record output in these States, the movement was one of expansion; between 1923 and 1928 total packs increased from nearly 15½ million cases of all sizes to just over 27¾ million cases. Since 1928, however, there has been a marked shrinkage, and although the 1930 figure was as high as 25½ million cases, output in 1931 fell to under 19 millions, and last year to 15 millions, the lowest since 1924.

Production in California accounts for the greater part of the total, and the proportion, which in earlier years had shown signs of decline, has remained at 70 per cent. in the past two years. The output of the Californian canneries reached its peak in 1926, when nearly 21 million cases were packed, and although in 1928, the year of the record peach pack, this figure was nearly attained, there has since been no indication of production of these dimensions. Last year's total of 10½ million cases of all fruits was less than half the 1926 level, and was the smallest since 1924.

In the North-Western States, including Oregon, Washington and Idaho, expansion between 1923 and 1928, the record year, was substantial particularly in Oregon. In 1929 the decline started, and has since been consistently maintained, but at a less rapid rate than in California, except as regards the unimportant total for Idaho, which in 1932 was represented by the small pack of one canner. The output of 4,600,000 cases for Oregon and Washington in 1932 was a million cases below the previous year's total, and about the same as in 1925.

Table I shows total output by States since 1923 in cases of all grades and sizes. The figures in this table and in Table II are taken from the published statistics of the respective canners' associations—The Canners' League of California and the North-West Canners' Association.

TABLE I.—*Canned Fruit Packs in California and North-Western States in recent years. (Cases of all sizes).*

Year.	California.	North-Western States.				Total— California and North- West.
		Oregon.	Washing- ton.	Idaho.	Total.	
	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.
1923 ..	11,352	1,711	2,054	107	3,872	15,224
1924 ..	10,363	1,823	2,367	57	4,247	14,610
1925 ..	15,632	2,051	2,464	117	4,632	20,264
1926 ..	20,975	3,169	3,100	148	6,417	27,392
1927 ..	16,775	2,435	2,174	176	4,785	21,560
1928 ..	20,223	3,647	3,756	174	7,577	27,800
1929 ..	15,586	3,589	3,716	75	7,380	22,966
1930 ..	18,754	3,323	3,237	57	6,617	25,371
1931 ..	13,044	2,657	2,958	14	5,629	18,673
1932 ..	10,454	2,166	2,447	—	4,613	15,067

In 1932 all the major Californian packs showed reductions on the previous year and were substantially below the average for the five years 1927-31. The failure of the plan to control the peach output resulted in a higher pack than would otherwise have been the case, but the figures were more than 2 million cases, or over 23 per cent., less than in the previous year, and the smallest recorded since the relatively low level of 1924. Pears declined by about the same percentage, but for apricots the reduction was only 10 per cent., and cherries maintained their 1931 level.

While peaches, apricots and pears account for over 95 per cent. of the annual Californian canned fruit pack, the chief fruits canned in the North-West States are apples, pears, prunes and berries. The

apple pack in 1932 was 18 per cent. greater than in 1931, but pears showed a reduction of 7 per cent. and the combined pack of berry fruits, owing to the operation of a voluntary curtailment plan, was less than half as great. Loganberries, raspberries and blackberries were all under 50 per cent. of the previous year's figures, strawberries only showing a moderate increase, while prunes were reduced by 33 per cent. Every item in the range of North-Western packs, with the exception of the comparatively unimportant plum pack, was well below the five year average.

Table II shows the total output in recent years analysed by varieties. Fruit salad, which consists of fruit already accounted for in these figures, is not an additional item, and has not, therefore, been separately specified. Last year the pack amounted to 1,418,000 cases as compared with 1,385,000 cases in 1931 and 1,706,000 cases in 1930.

TABLE II.—*Canned Fruit Production in California and North-Western States, showing quantity of each variety packed.*

Variety.	1927.	1928.	1929.	1930.	1931.	Average 1927- 1931.	1932.
	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.	Thou- sand cases.
<i>California.</i>							
Peaches ..	11,150	14,975	8,365	13,772	8,599	11,372	6,588
Pears ..	1,930	2,337	2,102	1,967	1,895	2,046	1,476
Apricots ..	3,117	2,097	4,211	2,069	2,096	2,718	1,892
Cherries ..	171	280	394	388	209	288	207
Grapes ..	141	93	132	83	18	93	34
Plums ..	137	174	121	193	95	144	72
Other Fruits..	129	267	261	282	133	214	185 (a)
<i>North - Western States.</i>							
Apples ..	1,237	2,210	1,744	1,317	961	1,494	1,132
Pears ..	819	1,978	2,286	2,395	1,881	1,872	1,758
Apricots ..	—	—	14	—	19	7	3
Cherries ..	359	634	598	714	212	503	315
Loganberries	481	544	355	234	475	418	160
Raspberries ..	280	391	374	356	422	365	147
Gooseberries..	114	54	44	65	38	63	37
Strawberries..	335	270	296	149	186	247	198
Blackberries..	645	743	663	568	624	649	306
Prunes ..	461	706	939	668	759	707	507
Plums ...	3	3	16	76	1	20	29
Other Fruits..	50	44	51	75	50	54	21

(a) No 2½ can basis.

The Canned Peach Position

As in former years interest in California centred mainly round the canned peach position and the steps to be taken to bring production into line with consumption. The situation, difficult enough in itself, was further complicated by the competitive effect of the measures taken by the Hawaiian canned pineapple industry in its efforts to dispose of accumulated stocks.

In the autumn of 1931 pineapple prices were drastically reduced. This also forced down peach prices, and in an attempt to stabilise the position the Cling Peach Agency was formed in January, 1932, by which independent peach canners hoped to restore the 1931 opening price of 1.55 dollars per dozen for choice grade. But in face of the continual decline in the prices of other commodities it proved impossible to maintain peach prices and move fruit into consumption in sufficient quantities. The agency accordingly ceased to operate in July and prices dropped to 1 dollar a dozen and even lower, a level at which, it is estimated, cost of production was not covered.

The carry-over of canned peaches on the 1st June, 1932, was estimated at 4,450,000 cases, a considerable increase over the previous year, and much greater than had been anticipated in view of the reduced output in 1931. The large carry-over was the result of a sharp contraction in domestic demand as well as a shrinkage in exports, and it was clear that an effort would have to be made to restrict still further the 1932 pack. The majority of the canners appear to have been in favour of participation in a control programme similar to the one carried out in 1930 and 1931, but in spite of the obvious need for control it was found impossible to secure agreement, and canners were left to pack as much as they considered advisable. The control plan had contemplated the limitation of output to about $4\frac{1}{2}$ million cases, and on this basis there is little doubt that the 1932-33 season would have closed with a negligible carry-over, and that a substantial rise in prices would have occurred. Owing, it is believed, to the financial position of the canners the output was not so large as might have been expected having regard to the size of the crop, the final estimates giving just over $6\frac{1}{2}$ million cases as compared with about 8,600,000 cases in the previous year.

From the growers' point of view the year 1932 was a disastrous one, all the principal fruits yielding average returns considerably below those of the previous year. The harvested cling peach crop amounted to 328,000 tons, though additional tonnage could have been produced, but was abandoned or destroyed when the fruit was immature. This compares with 353,000 tons in 1931 and 428,000 tons in 1930, these figures including tonnage purchased on the trees but not harvested. But although supplies were shorter the average farm value is estimated by the California Co-operative Crop Reporting Service to have been only 10.4 dollars per long ton as against 18 dollars in the previous year and 22.4 dollars in 1930. Prices paid by canners for fresh fruit also declined to new low levels, the average being about 7.3 dollars as compared with 16.24, 22.4 and 89.6 dollars per (long) ton in the three previous years.

The acreage under cling peaches in California has been declining for several years. In 1929 the total, including a non-bearing acreage of 10,500 acres, was 82,631, but by 1931 it had fallen to 73,289 acres (including 3,854 acres not in bearing), and it is estimated that in 1932 bearing acreage had declined to 61,432 acres and non-bearing to 2,584 acres. A further decline is anticipated in 1933 and the Cling Peach Control Committee have reported that the acreage expected to bear fruit in the 1933 season is about 46,000, or enough to supply 12 to 13 million cases without taking into account the Southern California production and the acreage under Tuscan. Up to the present the question of whether the 1933 pack shall be controlled has not been decided, but it is certain that, even with the comparatively small carry-over in prospect, a pack of these dimensions will not be contemplated except in the rather unlikely event of a very material improvement in general conditions.

Hawaiian Canned Pineapple

The 1931 packing season yielded the record output of 12,808,000 cases, which represented a reduction of over 3 million cases on the estimates of the possible output made earlier in the season. The curtailment of the pack was secured by a decision to can only the best quality fruits; lower grade fruits were discarded, and it was estimated that only about 75 per cent of the 1931 crop was harvested.

Considerable difficulty was experienced in moving the large production and at the end of May 1932, just before the new season commenced stocks not disposed of were stated to amount to about 5½ million cases. It was evident that drastic curtailment would have to be enforced to avoid the recurrence of an exceptionally heavy carry-over at the opening of the 1933 season, and discussions were opened among the packers with the view of effecting agreement on a concerted plan. Some time elapsed, however, before agreement was reached, and there is not much doubt that the failure of the Californian peach curtailment plan, which introduced the possibility of a heavy supply of canned peaches, helped materially in bringing about a decision.

As a result the Pineapple Producers' Co-operative Association, Ltd., consisting of the seven major packers was formed, and the effect of this action was to bring the whole output under control. The purpose of the new association was to stabilise the industry and to introduce a more orderly marketing system designed to eliminate surpluses and shortages. Canned pineapple stocks of all members were to be regulated by the Association, output being arranged on a quota basis for each producing unit, but existing channels of distribution were to be maintained. Each of the canning companies selling pineapples, whether under their own labels or under those of distributors, would continue to operate as before, and existing containers, now standardised for some years, were to be maintained, with some minor exceptions. The agreement originally provided for the regulation of the 1932 and 1933 packs, but after further consideration it has been decided to extend it to ten years.

The first effect of the formation of the Association was a general agreement to limit the 1932 pack to 5 million cases, and the actual quantity produced up to December, 1932 fell just short of this figure, though it may be that by the close of the year (in June) the total will reach about 5½ million cases. This drastic reduction from the high level of the previous year brings the Hawaiian output down to about the 1921 level and amounts in effect to restarting the industry on a new basis. Consumption during the season is reported to have been better than a year earlier, but it is anticipated that in the season commencing in July (1933) the pack will be restricted to the same figure as in the previous season, viz., about 5 million cases.

Figures of output are given in the following table :—

TABLE III.—*Hawaiian Canned Pineapple Production.*

Period or Year.	Production.
<i>Average Annual Output, Five Years.</i>	<i>Thousand cases.</i>
1907-11	421
1912-16	2,106
1917-21	4,555
1922-26	7,032
1927-31	10,447
<i>Yearly Output.</i>	
1926	8,940
1927	8,879
1928	8,663
1929	9,211
1930	12,672
1931	12,808
1932	5,296(a)

(a) Estimated. Complete figures not available.

Canned Grapefruit

The production of canned grapefruit in the United States is almost entirely confined to the State of Florida. For some years expansion was fairly consistent and the record was reached in the 1930-31 season with a total of 3,124,000 cases of fruit and juice. In 1931-32, however, there was a sharp decline, and the total of 1,154,975 cases (including 247,652 cases of juice) was little more than one-third of the output in the previous season, and about the same as the quantity produced in 1928-29. The explanation of this marked reduction appears to be that packing was curtailed on account of lack of orders and an advance in the price of the raw fruit which precluded production at the old levels.

Pack figures for the seasons 1926-27 to 1931-32 are given in the following table.

TABLE IV.—*Florida Canned Grapefruit Packs in the seasons, 1926-27 to 1931-32.*

(In thousand cases of 24 No. 2 cans).

Description.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
Fruit	700	575	950	1,317	2,712	907
Juice	—	—	205	174	412	248

The opening of the 1932-33 season was delayed, and packing had not been completed by the end of March. Complete figures for the season are not, therefore, yet available, but production up to the 1st April, 1933, was stated to be 1,402,000 cases, a fairly substantial advance on the previous season's total.

Production of canned grapefruit in Porto Rico declined to a practically negligible proportion of the total supply in the 1931-32 season, the output being estimated at about 83,000 cases only, as compared with 215,000 cases in the previous season. Prior to 1931 no production statistics were available, but exports from Porto Rico to the mainland form a fairly reliable indication of the size of the pack. On this basis it would appear that production in Porto Rico reached its peak in 1930 when 420,000 cases were exported to the United States.

Disposition of supplies of certain packs

Table V shows the packs of the three fruits—apricots, peaches and pears—for the years 1927 to 1931, the estimated carry-overs at the end of each season, and the quantity of fruit disposed of during the twelve months June to May. For apricots and peaches the pack figures given are the output of the Californian canners, and the figure for pears represents the combined production of California and the North-western States. These figures are expressed on the No. 2½ can basis, which accounts for any differences noted between them and the figures given in Table II on page 67. The estimates of carry-over at 1st June of each year used in the table were compiled by the Giannini Foundation of Agricultural Economics of the University of California, and these also are given in cases of 24 No. 2½ cans. It may be noted that these figures differ to a certain extent from the figures published by the Canners' League, but the variations tend to

cancel out from year to year, with the result that the estimated quantity disposed of during the season is much the same on either basis.

TABLE V.—*Seasonal supplies of Californian Apricots and Peaches and Pacific Coast Pears in recent seasons.*

Fruit and Season.	Carry-over from previous season (1st June).	Pack.	Total available.	Carry-over to following season (1st June).	Disposed of during season (including exports).
<i>Apricots.</i>	000 cases.	000 cases.	000 cases.	000 cases.	000 cases.
1927-28	401	2,960	3,361	952	2,409
1928-29	952	1,991	2,943	154	2,789
1929-30	154	4,023	4,177	1,189	2,988
1930-31	1,189	1,954	3,143	546	2,597
1931-32	546	2,006	2,552	515	2,037
<i>Peaches.</i>					
1927-28	3,906	10,813	14,719	1,516	13,203
1928-29	1,516	14,596	16,112	3,149	12,963
1929-30	3,149	8,100	11,249	1,677	9,572
1930-31	1,677	13,294	14,971	3,951	11,020
1931-32	3,951	8,420	12,371	4,845	7,526
<i>Pears.</i>					
1927-28	402	2,648	3,050	167	2,883
1928-29	167	4,124	4,291	293	3,998
1929-30	293	4,221	4,514	932	3,582
1930-31	934	4,175	5,109	893	4,216
1931-32	893	3,652	4,545	873	3,672

The five seasons 1927-28 to 1931-32 cover the transition from peak consumption levels with expanding packs, to the point where production and demand were completely out of adjustment. For apricots the decline started in 1930, and for pears a year earlier. Consumption of peaches reached its maximum in 1927-28 and has since fallen rapidly. Both peaches and pears showed some response to the lower level of prices in 1930, but there were further serious declines in the 1931-32 season, when the quantity of peaches disposed of in the domestic market and by export was 43 per cent. below the peak season, 1927-28. The consumption of apricots and pears was much steadier, though there were considerable fluctuations over the period.

With declining consumption the size of the carry-overs has become an urgent problem, and the extent of the mal-adjustment can be measured by the increasing proportion of carry-over to the total available supply each season. By 1931-32 this was as high as 40 per cent. for peaches as compared with 26 per cent. in the previous year and only 10 per cent. in 1927-28.

In Table VI is shown the distribution of supplies each season as between the domestic market and exports, the proportion of the total exported to the United Kingdom being separately distinguished. As in Table V case figures are expressed throughout on the 2½ can basis.

TABLE VI.—Disposition of seasonal supplies of Apricots, Peaches and Pears between Domestic and Export Markets.

Fruit and Season.	Total disposed of during season.	Domestic Shipments.	Total Exports (June to May).	Percentage of total disposed of as exports to	
				All Countries.	United Kingdom.
<i>Apricots :—</i>	000 cases.	000 cases.	000 cases.	Per cent.	Per cent.
1927-28	2,409	1,779	630	26	21 (a)
1928-29	2,789	2,195	594	21	15
1929-30	2,988	2,259	729	24	19
1930-31	2,597	2,183	414	16	13
1931-32	2,037	1,541	496	24	18
<i>Peaches :—</i>					
1927-28	13,203	11,163	2,040	15	11 (a)
1928-29	12,963	10,800	2,163	17	12
1929-30	9,572	7,845	1,727	18	13
1930-31	11,020	9,402	1,618	15	12
1931-32	7,526	6,057	1,469	20	17
<i>Pears :—</i>					
1927-28	2,883	1,647	1,236	43	36 (a)
1928-29	3,998	2,177	1,821	46	41
1929-30	3,582	2,419	1,163	32	28
1930-31	4,216	2,621	1,595	37	35
1931-32	3,672	2,004	1,668	45	43

(a) July to June.

The export market is a much more important factor in the pear supply position than it is in the case of peaches and apricots. In recent years an average of about 40 per cent. of the total quantity of pears disposed of during the season has gone overseas as compared with 17 per cent. for peaches and 22 per cent. for apricots; the bulk of the exports of each fruit, over 80 per cent. in most years, is consigned to the United Kingdom. In the past three seasons there has been a continuous expansion in exports of pears, but exports of peaches have declined each season since 1928-29. On the whole, however, exports have been steadier than shipments to the domestic markets, and have tended in the past two or three seasons to absorb an increasing proportion of the total disposed of.

EXPORTS OF CANNED FRUITS FROM THE UNITED STATES

(i) 1931-32 Season

The canned fruit export season in the United States naturally varies slightly for the different varieties, but by the end of June shipments of old pack fruits have generally practically ceased, and it is therefore convenient to regard the season as running roughly from July to June, although shipments of the new pack in some cases may not commence until August or September.

In the twelve months ending June, 1932, total exports of canned fruits continued the decline which started in the 1928-29 season, and the total of 2,231,000 cwts. shows a decrease of 189,000 cwts. or 8 per cent. on the aggregate for the preceding year and over 24 per cent. on the total for the 1928-29 season. Peaches, pears and pineapples, normally the principal items, all declined, as compared with the previous year, the reduction being particularly marked for peaches and pineapples. The small exports of berries other than loganberries, cherries, prunes and the unclassified canned fruits (including grapefruit) were also reduced, but apricots, loganberries, apples and fruit salad all showed increases. As compared with 1928-29, the peak in recent years, the decline was especially pronounced in the case of peaches (35 per cent.), pineapples (55 per cent.) and apples (40 per cent.), but apricots (12 per cent.), pears (13 per cent.) and berries

(26 per cent.) also show a reduction, the only increase recorded being for the group of miscellaneous fruits (including fruit salad and grapefruit) which rose from 244,000 cwts. to 363,000 cwts.

Total exports in the seasons (July to June) 1927/28 to 1931/32 are shown in Table I.

TABLE I.—*Exports of Canned Fruits from the United States.*

Fruit.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apricots	259.0	234.4	296.7	169.8	206.8
Peaches	773.6	905.6	664.9	676.4	588.4
Pears	470.3	738.0	488.4	663.9	639.0
Pineapples	457.4	424.4	413.5	315.2	191.1
Loganberries	(a)	(a)	(a)	37.6	69.6
Other Berries.. .. .	93.1	107.3	89.4	12.1	9.7
Apples and Apple Sauce ..	122.7	246.6	187.7	137.2	148.9
Fruit Salad	(b)	(b)	269.2	282.3	287.6
Cherries	15.3	19.7	17.0	11.0	5.8
Prunes	21.8	24.8	18.0	15.0	9.3
Grapefruit	(b)	(b)	(b)	(b)	59.4
Other Canned Fruits ..	71.3	244.2	97.2	99.8	15.9
TOTAL ..	2,284.5	2,945.0	2,542.0	2,420.3	2,231.5

(a) Included in "Other Berries."

(b) Included in "Other Canned Fruits."

In July, the first month of the season, total exports substantially exceeded the figures for the corresponding month of 1930; there was a slight decline in August, and September exports were well below those of the previous year, with the result that the increase for the three months July to September was barely 3 per cent. Heavy shipments of the principal fruits in October and November especially to this country, increased the advance to over 20 per cent. for the five months ended November. But in December there was an exceptionally severe decline, shipments falling to less than half the November total, and the increase over the first half of the previous season was accordingly reduced to 8 per cent.

With the exception of slight recoveries in January and March the decline which thus set in in December was continued for the remainder of the season. The decline was, of course, partly seasonal, but exports during the period were consistently at an appreciably lower level than in the previous year. By the end of March the increase of 8 per cent. recorded at the half year was converted into a decrease of 9 per cent. for the nine months, and the season closed with total exports 8 per cent. smaller than in the same period of 1930-31.

The destinations of exports of canned apricots, peaches, pears and pineapples, the only fruits for which such details are available in the United States Trade Returns are given in Table II below.

This table illustrates the importance of the United Kingdom as a market for these fruits, particularly apricots, peaches and pears. Moreover, in the past three seasons the relative importance of this country has increased. In the season ending July, 1931, apricots consigned to the British market represented 81 per cent. of the total exports of this fruit, the corresponding figures for peaches, pears and pineapples being 84, 92 and 37 per cent. Each of these figures showed an advance on the 1929-30 season when exports to the United Kingdom accounted for 80 per cent. of the apricots, 73 per cent. of the peaches, 87 per cent. of the pears and 31 per cent. of the pineapples. In the season just closed when apricots were the only fruit, exports of which increased, shipments to this country were maintained at a comparatively higher level than those to other countries, and except for pineapples the proportions were again higher being 87 per cent. for apricots, 88 per cent. for peaches and 95 per cent. for pears; pineapples were slightly less at 36 per cent. Continental Europe is normally the principal market for Hawaiian pineapples, and last season half of the much reduced total exports were sent to these countries.

Apart from apricots which were over 30 per cent. greater, the actual quantities of these fruits coming to the United Kingdom were appreciably less, the decrease being smallest for pears and most pronounced for pineapples. Shipments of apricots and peaches to the Continent were slightly greater, but both pears and pineapples declined. The most important decrease, however, occurred in the exports to Canada the total for the four fruits amounting to 13,200 cwts. only as compared with 90,500 cwts. in the previous season.

TABLE II.—*Exports of certain Canned Fruits from the United States in July to June, 1930-31 and 1931-32.*

Country.	Apricots.		Peaches.		Pears.		Pines.	
	1930/31	1931/32	1930/31	1931/32	1930/31	1931/32	1930/31	1931/32
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
United Kingdom	138.1	181.5	566.4	520.6	613.9	607.5	115.3	69.9
Other Europe	17.0	19.6	44.5	46.4	21.3	18.7	133.2	103.7
Canada ..	6.0	.8	26.9	3.8	7.3	1.6	50.3	7.0
South America	.8	.3	3.3	1.3	2.0	1.6	—	—
Other Countries	7.9	4.6	35.3	16.3	19.4	9.6	16.4	10.5
Total ..	169.8	206.8	676.4	588.4	663.9	639.0	315.2	191.1
Equivalent in cases at 45 lbs. per case.	422,800	514,900	1,684,200	1,465,100	1,653,100	1,591,100	784,800	475,800

Although it is not possible to shew the destinations of the exports of the minor fruits by seasons, figures for calendar years up to 1931 are available for the majority of these fruits, and from these figures the normal proportion exported to this country can be seen. This difficulty will not arise in future as, beginning with July 1932, export figures shewing countries of consignment have been published monthly for most fruits.

Total exports of the minor fruits in the calendar years 1928 to 1932 are shewn in Table III which also gives exports to the United Kingdom for each year except 1932. It will be noted that by far the greatest proportion of the total exports of each fruit except cherries and prunes, is sent to the United Kingdom. In 1931 practically the whole of the loganberries and two-thirds of the small exports of other berries were exported to this country, which also took 92 per cent. of the apples and apple sauce, practically the same proportion of fruit salad, and about 80 per cent. of the canned grapefruit.

TABLE III.—Exports of certain Canned Fruits from the United States in the calendar years, 1928–1932.

Fruit.	1928.		1929.		1930.		1931.		1932.
	U.K.	Total.	U.K.	Total.	U.K.	Total.	U.K.	Total.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Loganberries									
Other canned berries	107.0	116.9	100.7	113.2	41.5	42.4	58.6	59.2	40.4
Apples and Apple Sauce.. ..	181.0	191.5	185.7	205.0	130.3	139.7	152.6	166.0	174.6
Cherries.. ..	2.6	19.7	2.5	18.5	2.6	12.6	1.3	7.6	5.3
Prunes	8.8	19.9	9.6	23.4	5.3	16.4	4.7	10.9	9.4
Fruit Salad			265.0	302.4	222.1	253.0	274.9	301.9	287.3
Other canned fruits	38.1	81.5	47.6	95.0	46.2	86.6	(a)67.1	(b)95.8	(c)76.4

(a) Including 59,000 cwts. of canned grapefruit.

(b) Including 74,000 cwts. of canned grapefruit.

(c) Including 62,000 cwts. of canned grapefruit.

(ii) Exports in the first half of the 1932-33 season (July to December 1932).

In the first six months of the present (1932-33) season (commencing July) exports totalled 1,493,000 cwts. (approximately 3,859,000 cases) as compared with 1,364,000 cwts. (3,564,000 cases) in the same period of last season. The principal increase was in exports of peaches, which advanced by 148,000 cwts. or 39 per cent.

Details of exports from the United States for the first six months of the 1932-33 season, with comparative figures for the previous season, are shown in Table IV. Total exports of each fruit are also given in standard cases of 45 lbs. net weight, except for berries and grapefruit, and apples, which have been converted at 28½ lbs. and 36 lbs., representing two dozen No. 2's and six No. 10's respectively,

TABLE IV.—*Monthly Exports of Canned Fruits from the United States.*

Month.	Apricots.		Peaches.		Pears.		Pines.		Berries.	
	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.
	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.	thousand cwts.
July	35.9	33.9	50.9	38.1	32.0	18.2	9.1	7.4	24.2	12.8
August	18.0	21.4	86.4	130.0	48.1	43.7	25.8	7.6	10.1	3.2
September ..	18.8	51.2	58.9	222.8	81.3	181.2	21.1	15.7	5.8	8.5
October	34.3	18.7	97.6	71.0	126.9	103.7	12.3	26.9	13.6	1.3
November ..	15.7	7.6	58.3	28.1	75.7	32.8	26.9	10.5	5.4	1.5
December ..	8.9	9.1	26.6	37.0	36.0	27.5	13.8	9.5	1.9	2.2
Total—6 months	131.6	141.9	378.7	527.0	400.0	407.1	109.0	77.6	61.0	29.5
Equivalent cases.	327,700	353,300	943,000	1,312,200	996,000	1,013,700	271,400	193,200	239,700	115,900
	Apples and Apple Sauce.		Fruit Salad.		Grapefruit.		Other Fruits.		Total. All Fruits.	
July	8.1	3.6	19.3	22.7	6.3	3.6	1.8	2.1	187.6	142.4
August	3.4	7.3	22.9	14.3	1.4	9.8	3.1	1.7	219.2	239.0
September ..	2.5	6.6	27.3	69.4	3.4	3.7	5.3	5.6	224.4	564.7
October	16.3	53.6	46.5	33.0	3.2	1.4	4.6	4.1	355.3	313.7
November ..	48.7	24.3	30.4	7.9	1.6	0.3	3.1	2.8	265.8	115.8
December ..	8.8	18.0	11.7	10.5	1.8	1.4	2.1	2.1	111.6	117.3
Total—6 months	87.8	113.4	158.1	157.8	17.7	20.2	20.0	18.4	1,363.9	1,492.9
Equivalent cases.	273,100	352,800	393,700	392,900	69,600	79,400	49,800	45,800	3,564,000	3,859,200

The present export season has followed a markedly different course from the previous one, the principal difference being the large exports in September, mainly to this country in anticipation of the imposition of new duties under the Ottawa agreements. In July, the first month of the season, total exports were 24 per cent. less than a year earlier; there was a slight increase in August, but September exports were over two and a half times as great as in September 1931, the increase being due to large shipments of apricots, peaches, pears and fruit salad. As a result, total exports for the first three months of the season were 50 per cent. greater than in the previous year. In the next three months shipments declined, the total being over 25 per cent. less than in the same period of 1931. The increase in the first half of the season was accordingly reduced to under 10 per cent. It may be added that further comparative declines took place in the first four months of 1933, and at the end of April the decrease amounted to nearly 4 per cent. It is of interest to note that in the corresponding period of the 1931-32 season total exports showed a decline of the same dimensions over the first ten months of the 1930-31 season, and by the end of the season the decline had increased to 8 per cent.

The destinations of the exports of canned apricots, peaches, pears and pineapples for the first six months of the 1932-33 season (July to December), with comparative figures for the previous season, are given in Table V.

TABLE V.—*Exports of certain Canned Fruits from the United States, July to December, 1931 and 1932.*

Country.	Apricots.		Peaches.		Pears.		Pineapples.	
	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
United Kingdom	113.0	127.8	333.1	486.2	378.3	391.1	43.7	24.5
Other Europe ..	14.9	11.8	31.1	22.0	13.2	4.9	55.3	37.4
Canada ..	0.6	0.4	2.6	2.1	1.4	0.4	4.1	2.0
Other Countries	3.1	1.9	11.9	16.7	7.1	10.7	5.9	13.7
Total (6 mos.)..	131.6	141.9	378.7	527.0	400.0	407.1	109.0	77.6
Equivalent in cases at 45 lbs. per case ..	327,700	353,300	943,000	1,312,200	996,000	1,013,700	271,400	193,200

During the first six months of the season total exports to the United Kingdom amounted to 1,340,000 cwts. Of this total peaches accounted for 486,000 as compared with 333,000 cwts. in the previous year and pears for 391,000 cwts. against 378,000 cwts. Apricots also showed an increase, exports to this country in the July to December period in 1931 being 113,000 cwts. as compared with 128,000 cwts. a year later, but there was a substantial decline in the case of pineapples, the comparative figures for 1931 and 1932 being 44,000 cwts. and 25,000 cwts. Exports of these four fruits to markets other than the United Kingdom, however, all registered declines.

Prior to July, 1932, the destinations of exports of fruits other than apricots, peaches, pears and pineapples were not published in the United States monthly trade returns. It is not therefore possible to give comparative figures in Table VI, which shows exports of canned loganberries, other berries, fruit salad, etc., in the six months ended December, 1932. In this table total exports have also been given in cases, the basis of conversion being as follows: berries and grapefruit, 28½ lbs. per case (24 No. 2's); apples and apple sauce, 36 lbs. per case (6 No. 10's); fruit salad and other fruits, 45 lbs. per case (24 No. 2½'s).

TABLE VI.—*Exports of Canned Berries, Fruit Salad, etc., from the United States, July to December, 1932.*

Country.	Logan-berries.	Other Berries.	Apples and Apple Sauce.	Fruit Salad.	Grapefruit.	Other Fruits.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
United Kingdom ..	24.5	3.4	106.5	147.6	19.6	10.4
Other countries ..	0.1	1.5	6.9	10.2	0.6	8.0
Total ..	24.6	4.9	113.4	157.8	20.2	18.4
Equivalent in cases	96,700	19,300	352,800	392,900	81,950	45,800

UNITED STATES PRODUCTION AND EXPORTS OF CANNED VEGETABLES

I.—PRODUCTION

In common with many other commodities, the production of canned vegetables in the United States, which is considerably more important than the production of canned fruits, has declined in recent years. Complete figures are not available for 1932, but according to the 1931 Census, the canned vegetable output, including canned sauces and soups, amounted to 105 million cases, valued at 211 million dollars, as against 130 million cases with a value of 320 million dollars in 1929. The 1931 total compares with a canned fruit production of nearly 29 million cases having a value of 79½ million dollars, and these figures also showed a sharp decline on the previous Census compilation.

Tomatoes (including tomato paste and puree, etc.), peas, baked beans and corn are the largest packs in most years and accounted for about 60 per cent. of the total in 1931, but the production of some of the less important packs, such as spinach, was over 1 million cases, while the output of canned kraut was not much short of 4 million cases, and beans other than baked beans (including green, wax and Lima beans) exceeded 12 million cases. Complete statistics for all the packs are not available for every year, but figures for some of the more important items are published annually by the various Canners' Associations, and these are shown in Table I for the past six years. About 95 per cent. of the asparagus and 75 per cent. of the spinach produced in the United States comes from the Pacific Coast States, and details of these have been included in the table, although they do not represent aggregates for the whole country, as do the other figures.

The general decline in the output of these packs, which was so noticeable a feature of the 1931 figures, was with one important exception continued in 1932. Corn, which showed a substantial increase in the previous year fell to under half the 1931 figure, but the production of canned tomatoes rose from about 9½ million cases to 16 million.

TABLE I.—United States Production of certain Canned Vegetables, 1927–1932.

Vegetable.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.	Thousand cases.
Asparagus (a) ..	2,190	2,338	2,673	2,663	1,775	1,334
Beans—baked(b) ..	17,887	(e)	17,204	(e)	11,736	(e)
green(c) ..	4,037	5,227	7,245	6,739	4,871	3,435
wax(c) ..	639	988	1,284	1,511	1,196	588
Beets(c) ..	1,130	1,294	2,004	2,923	1,614	1,044
Corn(c) ..	10,347	14,497	17,487	15,692	19,415	9,358
Peas(c) ..	12,936	17,943	18,530	22,035	13,286	10,367
Spinach(a) ..	1,997	2,905	4,197	1,568	1,340	887
Tomatoes(d) ..	13,137	8,539	14,145	16,998	9,573	16,028

(a) Cases of all sizes, California and North-West only.

(b) Cases of all sizes.

(c) Cases of 24 No. 2's.

(d) Cases of 24 No. 3's (except 1932—cases of all sizes).

(e) Not available; 1927, 1929 and 1931 are Census figures.

II.—EXPORTS

By far the greater part of the canned vegetable output of the United States is consumed within the country, exports forming only a small proportion of the total. The United Kingdom and Canada are the chief markets, but the quantity absorbed by these two countries usually accounts for barely half the total exports, the balance going in small quantities to a wide range of countries in all parts of the world.

The peak of exports in recent years occurred in 1929 when the total was 581,000 cwts. Since then the decline has been rapid and the total of 218,000 cwts. for 1932 amounted to under 40 per cent. of the 1929 figure. Some part of this decrease was due to the smaller output, but the generally depressed condition of the world's markets was also an important factor. As compared with the peak year exports of asparagus in 1932 had shrunk to one-half, baked beans to less than half, while corn was only one-sixth as great. The 1932 total for peas amounted to only one-quarter of the 1929

figure; exports of tomatoes, on the other hand, showed a small increase.

Exports both to the United Kingdom and Canada have shared in the general decline, although the quantity taken by the latter country has diminished more rapidly. The total of 41,000 cwts. exported to Canada in 1931 was less than one third of the aggregate for 1929, whereas the total of 87,000 cwts. sent to the United Kingdom represented a fall of about 40 per cent. As compared with 1929 all varieties exported to the United Kingdom in 1931 showed reductions except baked beans, which were substantially larger; there was also a slight increase in the small exports of corn. During the same period exports of all kinds of United States canned vegetables to Canada declined, the extent of the decreases varying from 90 per cent. for baked beans to 10 per cent. for tomatoes, although, in these years, there was a marked diminution in the output of Canadian canned vegetables.

Total exports of canned vegetables from the United States are shown in Table II, which also gives exports to this country.

TABLE II.—*Exports of Canned Vegetables from the United States.*

Vegetable.	1927.	1928.	1929.	1930.	1931.	1932.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Asparagus ..	137.2	158.2	204.0	133.7	119.4	97.1
<i>United Kingdom</i>	18.1	16.5	25.4	17.9	13.9	(a)
Baked beans and pork and beans ..	128.8	125.2	68.4	86.6	64.4	30.6
<i>United Kingdom</i>	80.0	79.7	26.0	62.6	47.8	(a)
Corn ..	44.8	71.3	74.7	54.6	28.1	12.1
<i>United Kingdom</i>	4.4	5.1	5.9	7.3	6.4	(a)
Peas ..	54.6	57.9	74.9	61.5	40.5	18.7
<i>United Kingdom</i>	6.3	10.0	11.3	8.1	7.6	(a)
Tomatoes ..	56.5	50.2	41.7	32.3	28.3	41.9
<i>United Kingdom</i>	4.5	21.5	10.4	7.3	9.0	(a)
Other canned vege- tables ..	88.4	97.9	117.2	61.3	30.8	17.6
<i>United Kingdom</i>	55.2	57.3	65.4	18.4	2.0	(a)
Total ..	510.3	560.7	580.9	430.0	311.5	218.0
<i>United Kingdom</i>	168.5	190.1	144.4	121.6	86.7	(a)

(a) Not available.

PINEAPPLE CANNING IN FORMOSA

Although, as yet, of small importance in world trade, the development of the pineapple canning industry in Formosa in recent years has been rapid, and the estimates of output for 1932 point to further progress. Active attention is being given to research work, which, it is expected, will improve the flavour of the fruit and enable it to compete in foreign markets.

According to a report received from official sources the acreage under pineapple cultivation in 1932 was estimated at 16,300 acres, or an advance of over 30 per cent. on the total of 12,300 acres in 1931. The area has doubled since 1928, when the total was 7,400 acres and acreage for 1924 has been more than trebled. The area under pineapple in recent years is shown in Table I.

TABLE I.—*Area under Pineapple Cultivation in Formosa.*

Year.	Acreage.	Year.	Acreage.
1925	5,237	1929	9,164
1926	5,496	1930	12,596
1927	6,847	1931	12,322
1928	7,385	1932	16,279 (estimated)

The growing proportion of the superior varieties in the total is significant. In 1928 the common or indigenous varieties occupied 6,900 acres and the better or imported kinds 490 acres (or under 7 per cent.). By 1932 the native sorts had increased to an estimated figure of 12,200 acres, and the superior type (Smooth Cayenne and Sarawak) to 4,100 acres (or more than 25 per cent. of the total area.)

The number of plants in 1931 was 97 million or double the total of 47 million in 1928, while production rose from 36 million pieces in 1928 to 96 million pieces (estimated) in 1932. The quantity of pineapple packed in 1932 is estimated at 32,500,000 cans, or 3 million cans more than in 1931, and treble the amount canned in 1927. Particulars for recent years are shown in Table II.

TABLE II.—*Production of Canned Pineapple in Formosa.*

Year.	Thousand Cans.	Year.	Thousand Cans.
1927	10,301	1930	18,004
1928	8,493	1931	29,579
1929	20,185	1932	32,537 (estimated)

The greater part of the annual production of canned pineapple is shipped overseas. Exports have more than doubled in the course of four years, being estimated at 2,200,000 dozen tins for 1932, as compared with 2,000,000 dozen in 1931, and 830,000 dozen in 1928. Virtually the whole of these shipments went to Japan, consignments to other markets being of negligible proportions, and showing little sign of increase. Exports in recent years are given in Table III, in which separate particulars are shown for Japan.

TABLE III.—*Exports of canned Pineapple from Formosa.*

Exported to	1927.	1928.	1929.	1930.	1931.	1932 (a).
	Dozen.	Dozen.	Dozen.	Dozen.	Dozen.	Dozen.
Japan	868,209	829,008	1,339,901	1,237,772	2,002,305	2,202,535
Other countries	8,553	1,128	4,208	9,699	6,281	6,909
Total ..	876,762	830,136	1,334,109	1,247,471	2,008,586	2,209,444

(a) Estimated.

The only quantity recorded as exported to the United Kingdom during the period covered by the above table was 5,400 dozen tins in 1930. This was probably in the nature of an experimental consignment, as none has since been reported. No imports direct from Formosa have been recorded in the Trade Returns of the United Kingdom, but it is probable that the quantities registered as having been consigned from Japan originated in Formosa. Imports from Japan in 1930 totalled 850 cwts. and fell to 80 cwts. in 1931, while in 1932 they increased to 1,755 cwts.

THE RUSSIAN CANNING INDUSTRY

During the four years 1929-1932 the total output of the canning industry in Russia, according to reports in the Russian press, amounted to over 2,027 million cans, of which some 743 million cans were produced in 1932. This total is substantially in excess of the quantity laid down in the Five Year Plan, which provided for 1,682½ million cans of all kinds of canned foods.

These figures afford some indication of the substantial dimensions attained by the Russian canning industry. In recent years 79 factories for the production of canned foods have been constructed, and 70 of these were put up during the past five years. The total annual capacity of the industry is estimated at 900 million cans, and a further nineteen factories with a capacity of 350 million cans are reported to be in process of construction, bringing the total potential output to 1,250 million cans annually. In considering these figures it must be borne in mind that they represent the production possible when the factories are worked at full capacity, and on this basis the actual pack of 743 million cans in 1932 appears to have fallen short of the possible output, estimated at over 900 million cans. Against this, however, must be set the fact that some of the factories may not have been completed for full operation during the 1932 season and that the planned production of 650 million cans was exceeded by a considerable margin. Pre-war production has been estimated at 80 million cans, and a comparison of this figure with that of 1932 gives a measure of the advance.

A substantial proportion of the total pack consists of canned meat and canned fish, of which 97 million and 173 million cans respectively were produced in 1932; but canned fruit and vegetables accounted for the bulk. A comparison of output in 1929 and 1932 can be made from the following figures, published in the Bulletin of Economic Information of the Chamber of Commerce of the U.S.S.R.

	1929.	1932.
	<i>Million cans.</i>	<i>Million cans.</i>
Canned beans with pork	—	25
Canned tomatoes	26	100
Other canned vegetables	22	74
Canned fruit	23	271
	—	—
	71	470
	—	—

No indication is given of the can unit on which these figures are based, but it may be noted that the 400 gram can (about 14 ozs.) is the one usually specified. Details of the fruits and vegetables comprising these totals are lacking, but the fruits included apples, apricots, peaches, pears and cherries. Canned pork and beans were produced for the first time in 1932, and it is hoped to stimulate on the collective farms the cultivation of vegetables and fruit, introducing new varieties suitable for canning, such as asparagus, beans and peas.

Exports of canned fruits and vegetables from Russia form a negligible proportion of the total output, and this appears, in the main, to be due to the demand for home consumption. There was a substantial decline in exports of both classes in 1932 as compared with 1931, and although no details of the destinations of the exports are available, it seems clear that in recent years the United Kingdom has been the most important market, at any rate for canned fruit. An examination of the figures of recorded imports of canned fruits into this country from Russia reveals a marked downward trend, as the figures in the following table show. Probably the most important feature of this table, apart from the smallness of the figures by comparison with total imports, is the increase in 1932 in imports of fruit preserved with sugar, and the sharp decline in canned and bottled fruit preserved without sugar, which consists almost entirely of canned apples.

Imports of Canned or Bottled Fruits from Russia into the United Kingdom

Description.	1930.	1931.	1932.
1. Fruit preserved in sugar.	Cwts.	Cwts.	Cwts.
Apricots	268	102	852
Peaches	96	746	1,254
Pears	513	619	1,882
Other sorts	2,780	1,510	38
Total	3,657	2,977	4,026
2. Fruit preserved without sugar.			
Apricots and apricot pulp ..	157	3,406	—
Other sorts	10,420	9,504	6,050
Total	10,577	12,910	6,050
Total—Canned or Bottled ..	14,234	15,887	10,076

Imports from Russia of fruit preserved without sugar, not in cans or bottles, which are almost entirely fruit pulp, were of far greater importance than the types considered above, until a steep decline in 1932 brought them to a comparatively low level. In 1930 imports of this class totalled 34,657 cwts.; in 1931 the quantity imported rose to 55,096 cwts., but this was followed in 1932 by a decline to only 4,463 cwts. Of the latter total 2,743 cwts. consisted of black-currant pulp, and this variety probably accounted for a large proportion of the aggregates in previous years, though strawberry and other pulps were also included.

PART II.—DRIED FRUITS

IMPORTS OF DRIED FRUITS

Imports of dried fruits of all kinds in 1932 totalled over four million cwts. with a value of nearly £7½ millions. This quantity represented an increase on the previous year of nearly 20 per cent., and exceeded by 7 per cent. the large total imported in 1929.

All classes of dried fruit except the comparatively small imports of figs and fig cake shewed increases over the previous year's figures. Imports of raisins and sultanas were about 35 per cent. larger than the rather low figure of the previous year, the increase being mainly due to the heavy shipments in the autumn of foreign fruit, especially from Turkey, Greece and Crete; the total received from Empire countries was about 15 per cent. smaller than in 1932, whereas imports of foreign fruit increased by over 60 per cent. The larger import of currants was also due to the increased quantities received from foreign sources.

Among the dried tree fruits the most important are dates, and imports, which come almost entirely from foreign sources, were 16 per cent. larger in 1932 than in the preceding year, though not so heavy as in 1928. Imports of plums, prunes and prunelloes, chiefly apricots and prunes, about 10 per cent. of which, on the average, come from Empire countries, exceeded the 1931 total by practically 30 per cent., mainly on account of much heavier entries from the United States and the Union of South Africa. The comparatively small imports of figs and fig cake, practically all of foreign origin

declined in 1932, but a small increase was registered in the entries of miscellaneous dried tree fruits consisting mainly of apples, peaches, pears and fruit salad.

Total imports of dried fruits in the past five years with values are given in Table I.

TABLE I.—*Imports of Dried Fruits into the United Kingdom in the years 1928–1932*

Fruit.	1928.	1929.	1930.	1931.	1932.
Quantity.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Raisins and Sultanas	1,394	1,602	1,373	1,242	1,678
Currants	1,109	1,103	1,199	1,056	1,138
Figs and Fig Cake	133	149	104	154	114
Plums, Prunes and Prunelloes ..	388	336	377	351	456
Dates	635	519	480	502	583
Unenumerated Dried Tree Fruits ..	67	57	58	55	59
Total	3,726	3,766	3,591	3,360	4,028
Value.	£000.	£000.	£000.	£000.	£000.
Raisins and Sultanas	2,910	3,257	2,566	2,487	3,336
Currants	2,637	2,357	2,212	2,161	2,280
Figs and Fig Cake	247	286	181	250	157
Plums, Prunes and Prunelloes ..	778	834	825	658	821
Dates	725	661	548	532	540
Unenumerated Dried Tree Fruit ..	182	138	125	111	113
Total	7,479	7,533	6,457	6,199	7,247

Examination of the average declared values of these fruits reveals the general decline common to all commodities in recent years, though it seems clear that the fall has been much less severe. In comparison with 1928 average declared values in 1932 were less by amounts varying from 5 per cent. for raisins and sultanas to 30 per cent. for the unenumerated dried tree fruits, whereas during that period the decline in general wholesale prices was in the region of 40 per cent.

Average declared values in the past five years are given in Table II.

TABLE II.—Average declared values (per cwt.) of Imports of Dried Fruits into the United Kingdom

Fruit.	1928.	1929.	1930.	1931.	1932.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
Raisins and Sultanas	41 9	40 8	37 5	40 1	39 9
Currants	47 7	42 9	36 11	40 11	40 1
Figs and Fig Cake	37 2	38 5	34 10	32 6	27 7
Plums, Prunes and Prunelloes	40 1	49 8	43 9	37 6	36 0
Dates	22 10	25 6	22 10	21 2	18 6
Unenumerated Dried Tree Fruits	54 4	48 5	43 1	40 4	38 4

IMPORTS OF RAISINS AND CURRANTS

Imports of raisins and sultanas in 1932 increased sharply from the low level of 1931, and constituted a record. Imports of currants were also greater, but fell short of the quantity imported in 1930.

Figures of imports in the past six years are given in Table I:—

TABLE I.—Imports of Raisins and Currants into the United Kingdom.

Country where consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
<i>Raisins and Sultanas.</i>						
Australia	565	286	720	654	375	301
Union of South Africa	29	45	22	20	55	58
Other Empire Countries	18	4	6	3	7	11
United States of America	531	691	391	316	456	454
Spain	178	116	123	125	126	131
Turkey	216	173	225	144	105	404
Greece and Crete	39	69	84	74	63	131
Other Foreign Countries	16	10	31	37	55	188
Total Empire Countries	612	335	748	677	437	370
Total Foreign Countries	980	1,059	854	696	805	1,308
Total	1,592	1,394	1,602	1,373	1,242	1,678
<i>Currants.</i>						
Empire Countries	96	12	240	268	209	184
Foreign Countries	1,128	1,097	863	931	847	954
Total	1,224	1,109	1,103	1,199	1,056	1,138

Imports of raisins and sultanas from Australia again declined for the third year in succession, and partly for this reason the share of the Empire in the total imports was reduced to 22 per cent. as compared with 35 per cent. in 1931, and nearly 50 per cent. in 1930. Australian currants also fell in volume and formed only 16 per cent. of the total as compared with nearly 20 per cent. in the previous year.

Imports of foreign raisins and sultanas increased by over 60 per cent. in 1932, the much greater volume of shipments from Turkey, following the large crop in that country, being mainly responsible. Imports from Spain and Greece and Crete were also larger, but entries from California were maintained at about the previous year's level. There was a considerable increase in shipments from the unclassified countries, the fruit included in this group being mainly of Russian and Persian origin, with some from Afghanistan.

Since the calendar year, to which the above figures relate, covers the last part of one shipping season and the first few months of the next in the case of all foreign countries shipping dried fruit to the United Kingdom, the figures do not give an accurate reflection of the successive crops available for shipment. Table II below shows for each foreign country imports during the last three years before and from the 1st September.

TABLE II.—*Seasonal Imports of Raisins and Currants.*

Country whence consigned.	1930.		1931.		1932.	
	January to August.	September to December.	January to August.	September to December.	January to August.	September to December.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
<i>Raisins.</i>						
United States of America.	137	179	166	290	114	340
Spain	2	123	4	122	1	130
Turkey	29	115	27	78	38	366
Greece and Crete ..	10	64	1	62	9	122
Other foreign countries	36	1	18	37	181	7
Total foreign countries	214	482	216	589	343	965
<i>Currants.</i>						
Foreign countries ..	195	736	215	632	240	714

Imports from Spain for the Christmas trade show little variation from year to year, and 1932, though showing a slight increase in the last four months, was not exceptional. The heavy crops in the Eastern Mediterranean countries were, however, reflected in the considerable expansion in imports from Turkey and Greece and Crete in the September to December period. Shipments in these months from the United States, where the crop was also heavy, were again appreciably greater than the high level attained in the previous year, in spite of the difficulties of the exchange position. But it should be remembered that in addition to the large crops in the major exporting countries, there was the prospect of an increase in the duty on foreign fruits, which no doubt acted as a stimulus to ship the largest possible quantity before the higher rate became effective.

CONSUMPTION OF RAISINS AND CURRANTS IN THE UNITED KINGDOM

As foreign raisins and currants are dutiable, figures of foreign fruit entered for home consumption, that is, upon which the import duty has been paid, may be taken as reflecting fairly accurately the rate of movement into distributive channels. Fruit of Empire origin is admitted duty free, and entries for home consumption cannot be used as an indication of the consumption movement, as entries are almost identical with imports. But figures of actual sales of Australian fruit are available from official statements published periodically in Australia, while the much smaller quantities of other Empire fruit imported may be assumed, without any great possibility of error, as passing directly into distribution.

These two sets of figures—duty paid clearances of foreign fruit and sales or imports of Empire fruit—taken together give a fairly reliable indication of the rate of movement of raisins and currants into distributive channels, and Tables I and II have been compiled on this basis, Table I showing sales of Empire raisins and sultanas and deliveries of foreign fruit from bond during 1932 and the two previous years, and Table II similar figures for currants.

TABLE I.—Sales and Deliveries from Bond of Raisins and Sultanas.

Month.	Deliveries or Sales.								
	1930.			1931.			1932.		
	Empire Sales. (a)	Foreign Deliveries.	Total.	Empire Sales. (a)	Foreign Deliveries.	Total.	Empire Sales. (a)	Foreign Deliveries.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January	32	30	62	77	33	110	—	51	51
February	18	22	40	26	31	57	19	44	63
March	41	29	70	77	32	109	1	37	38
April	39	39	78	79	33	112	12	50	62
May	72	38	110	72	27	99	57	46	103
June	29	44	73	43	25	68	59	41	100
July	36	37	73	62	18	80	29	24	53
August	55	42	97	87	20	107	17	48	65
September	72	55	127	152	66	218	23	150	173
October	90	153	243	44	176	220	36	444	480
November	100	161	261	3	194	197	36	345	381
December	49	80	129	1	84	85	3	45	48
Total—January to December	633	730	1,363	723	739	1,462	292	1,325	1,617

(a) Sales include total imports from South Africa.

Figures for calendar years cover parts of two seasons for both Empire and foreign fruit. Australian and South African raisins and currants begin to arrive in April or May, and during the first few months of the year the sales are of the preceding year's crop ; moreover, in most recent years there has been some carry-over at the time of the arrival of the new crop, and sales of old crop fruit have continued for some months into the following season. Foreign fruit sales are of the preceding year's harvest until the arrival of the new crop in September or October.

The autumn demand for raisins and currants is clearly shown in Tables I and II. The bulk of the foreign deliveries from bond are in October and November in preparation for the Christmas demand, and deliveries after the close of the year are relatively small.

Demand for Empire raisins and sultanas also tends normally to concentrate in the autumn, usually before the foreign fruit is on the market, but when the size of the foreign supplies likely to be available is known with a fair degree of certainty, and when forward sales of foreign fruit are being made.

Table I also shows the exceptionally heavy deliveries of foreign raisins and sultanas in October and November, 1932, a reflection partly of the heavy imports, particularly from Turkey and Greece, and partly of the anticipated increase in the rate of duty.

TABLE II.—*Sales and Deliveries from Bond of Currants.*

Month.	Deliveries or Sales.								
	1930.			1931.			1932.		
	Empire Sales.	Foreign Deliveries.	Total.	Empire Sales.	Foreign Deliveries.	Total.	Empire Sales.	Foreign Deliveries.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
January ..	11	33	44	15	62	77	3	66	69
February ..	13	30	43	33	41	74	—	63	63
March ..	4	47	51	32	44	76	1	48	49
April ..	8	49	57	27	73	100	7	44	51
May ..	19	62	81	11	51	62	16	39	55
June ..	19	39	58	29	36	65	21	50	71
July ..	31	30	61	62	21	83	24	30	54
August ..	30	21	51	45	25	70	20	13	33
September ..	26	31	57	45	42	87	35	64	99
October ..	15	271	286	6	232	238	22	289	311
November ..	9	207	216	5	162	167	17	175	192
December ..	3	74	77	4	81	85	17	72	89
Total—January to December ..	188	894	1,082	314	870	1,184	183	953	1,136

The increasing supplies of raisins and especially the development in imports from the Empire which begin to arrive in April or May, has tended to spread consumption rather more evenly over the year. In 1911-13, when Empire and foreign fruit were both dutiable, three-quarters of the annual deliveries from bond of raisins and sultanas, and over three-fifths of the deliveries of currants were effected in the four months September to December; releases or

sales in the corresponding period in the three years ended 1931 were about half the annual figures. In 1932 deliveries or sales in the September to December period constituted 67 per cent. of the total for sultanas and 61 per cent. of the total for currants, but last year was clearly exceptional for the reasons already explained and the figures have not therefore been included in the details shown in Table III.

TABLE III.—Average Sales of Dried Fruits, September to December.

Period.	Raisins and Sultanas.			Currants.		
	Total Deliveries or Sales.	Deliveries or Sales (Sept. to Dec.)	Proportion.	Total Deliveries or Sales.	Deliveries or Sales (Sept. to Dec.)	Proportion.
	Thousand cwts.	Thousand cwts.	Per cent.	Thousand cwts.	Thousand cwts.	Per cent.
1911-13 ..	691	517	74.8	1,260	784	62.2
1922-24 ..	995	624	62.7	1,215	598	49.2
1926-28 ..	1,259	754	60.0	1,183	621	52.5
1929-31 ..	1,453	759	52.2	1,117	605	54.2

The consumption of raisins and sultanas is more than twice as large as before the war, but consumption of currants has declined slightly; the declining trend has been accompanied in the past few years by an increase in the proportion sold for the Christmas trade.

Consumption of raisins and sultanas during the 1932-33 season, as measured by deliveries and sales, has been well above the normal for recent years, at least during the first seven months (September to March), for which figures are available. Deliveries and sales of currants in the same period were greater than in the previous year and exceeded the five-year average, but fell short of the corresponding figure for 1930-31. Currants have in fact followed a more or less normal course, the principal reason, no doubt, being that no change of duty was made in November, 1932, when the new rates were put into effect for raisins and sultanas.

Deliveries of foreign raisins and sultanas in October and November were very heavy, but it may be noted that in the subsequent months there was a pronounced decline. In the five months December to April deliveries and sales were little more than half the quantity for

the corresponding period of the previous season and about one-third of the 1930-31 figure. This suggests either that consumption has suddenly declined or that stocks in merchants' hands at the end of April were heavier than usual at this time, the latter alternative being the more likely. On the other hand, stocks in bonded warehouses at the end of April were not so heavy as in the same month in 1932 (67,000 cwts. as compared with 74,000 cwts.) and it seems probable that the necessary adjustments for the return to the normal trend had been made before the Australian new crop, which is reported to be appreciably heavier than in 1932, came on the market in any quantity. The position has no doubt been materially assisted by the shortness of last year's crop.

IMPORTS OF DRIED TREE FRUITS

Dried tree fruits are classified in the Trade Returns of the United Kingdom into four classes, (a) figs and fig cake, (b) plums, prunes and prunelloes, (c) dates, and (d) unenumerated dried fruits. Imports of these fruits during each of the past ten years are shown in Table I.

TABLE I.—Imports of Dried Tree Fruits into the United Kingdom 1923 to 1932.

Year.	Figs and Figcake.	Plums, Prunes and Prunelloes.	Dates.	Un-enumerated.
	cwts.	cwts.	cwts.	cwts.
1923 (a)	197,001	391,814	473,766	52,829
1924	268,886	446,642	772,435	76,480
1925	151,462	354,418	606,842	45,350
1926	207,952	399,970	500,089	55,684
1927	175,177	422,425	297,368	48,465
Five-year average . .	200,096	403,054	530,100	55,762
1928	132,792	387,631	634,702	67,042
1929	148,980	335,746	518,715	56,758
1930	103,510	377,403	479,929	58,087
1931	153,611	351,497	502,317	55,071
1932	113,954	456,236	583,116	58,595
Five-year average . .	130,569	381,703	543,756	59,111

(a) From 1st April, 1923, the figures are exclusive of imports into the Irish Free State.

Imports of figs in 1932 fell considerably below the total for 1931. On the other hand, plums, prunes and prunelloes reached a very high level, and dates were much in excess of the previous year, while the unenumerated varieties advanced slightly.

Between the quinquennium ended 1927 and that ended 1932 average yearly imports of figs showed a very substantial reduction. A slight fall, which would have been marked except for the heavy arrivals in 1932, was recorded in plums and prunes. The imports of dates, and of the unenumerated sorts advanced slightly. Taken as a whole the consumption of dried tree fruits appeared to be declining up to 1931, but there was a marked revival in 1932.

Figs and Fig cake.

Imports of figs and fig cake in 1932 from the principal countries of consignment, with comparative figures for the previous five years are shown in the following table—

TABLE II.—*Imports of Figs and Fig Cake into the United Kingdom.*

Country whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Empire countries ..	15	14	1,191	27	239	201
Asiatic Turkey	153,426	107,622	112,125	84,032	134,647	94,079
Greece	10,424	15,476	19,380	10,803	13,875	17,051
United States	8,589	5,238	10,813	4,360	182	43
Spain	1,002	547	1,467	912	2,058	655
France	103	101	121	78	82	2
Portugal	779	260	1,354	32	2	12
Other Foreign countries ..	839	3,534	2,529	3,266	2,526	1,906
Total	175,177	132,792	148,980	103,510	153,611	113,954

Imports of figs and fig cake from Empire countries are negligible ; the small amount received in 1932 included 152 cwts. from the Union of South Africa.

Turkey supplies the bulk of the imports, and the heavy decline in the total from all sources was due to the fall in consignments from that country, where the crop was estimated to be somewhat lower than

in 1931. Most of the remainder of the supplies are from Greece, shipments from which country were greater than in the previous year following the substantially larger crop. Imports from these two countries accounted for 97 per cent. of the total from all countries. The predominance of these two sources of supply has increased as, although small quantities are imported from Spain, the United States, and Portugal, arrivals from the latter two countries have fallen off in recent years.

Over 90 per cent. of the total imports of figs and fig cake are received in the months of September, October and November; October alone accounted for nearly half of the total in 1932.

Plums, Prunes and Prunelloes

The classification plums, prunes and prunelloes, includes green-gages, damsons, mirabelles and apricots, but the bulk consists of prunes and apricots.

Imports of plums, prunes and prunelloes in 1932 from the various countries of consignment, and comparative figures for the previous five years, are given in Table III.

TABLE III.—*Imports of Plums, Prunes and Prunelloes into the United Kingdom.*

Country of Consignment.	1927.	1928.	1929.	1930.	1931.	1932.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Union of South Africa ..	18,534	14,475	22,517	46,584	16,672	41,490
Australia	13,394	3,696	14,152	5,943	9,093	418
Other Empire countries ..	222	51	177	110	270	1,462
United States	381,186	363,224	279,422	311,814	320,286	401,481
Germany	684	1,953	8,581	7,321	1,325	4,253
France	5,088	3,017	4,090	3,018	2,467	1,440
Spain	1,441	615	60	38	119	270
Other Foreign countries..	1,876	600	6,747	2,575	1,265	5,422
Total Empire countries	32,150	18,222	36,846	52,637	26,035	43,370
Total Foreign countries	390,275	369,409	298,900	324,766	325,462	412,866
Total	422,425	387,631	335,746	377,403	351,497	456,236

Up to 1931, the imports of plums, prunes and prunelloes, though fluctuating from year to year, had shown a distinctly declining trend, but in 1932 there was a marked revival to the very high total of 456,000 cwts., which exceeded the previous year by 105,000 cwts. With the single exception of November, in which month the 1931 figure was greatly swollen in anticipation of the imposition of import duties in this country, every month in 1932 exceeded the corresponding month in 1931.

By far the greater part of this class of dried fruit is obtained from foreign countries, nearly all from the United States, which accounted for 401,000 cwts., or 81,000 cwts. more than in the previous year. The country next in importance, but which in 1932 accounted for only one-tenth as much as the United States, was the Union of South Africa. Supplies from Empire sources had been growing in importance, and had risen from under 8 per cent. of the total imports in 1927 to 14 per cent. in 1930, but in 1931, owing mainly to the small prune crop in the Union of South Africa, the Empire's share was reduced to 8 per cent., and in 1932, due to the small apricot harvest in Australia, the percentage was only 9 per cent.

The heading plums, prunes and prunelloes includes both dried apricots and prunes, but it is possible by examining the export returns of the principal countries of supply to arrive at some estimate of the relative importance of the two fruits in the total. Thus 97 per cent. of imports from the United States consist of prunes in normal years, and although in 1931, and again in 1932, the proportion of apricots was rather higher, prunes represented over 90 per cent. of the total. Imports from Germany and France are almost entirely prunes or plums and consignments from Australia are normally mostly apricots. The export returns of the Union of South Africa show that apricots accounted for about three-quarters of the exports in 1932, with prunes making up the balance, but in most years the percentage of prunes is much higher and in 1931 comprised almost the whole of the shipments.

The heaviest quantities of this class of fruit are imported in November, December and January following the harvests in California and Oregon, but fair quantities are imported at all times of the year.

Dates

Details of imports of dates into the United Kingdom from the various consigning countries in 1932 are shown in Table IV, in which particulars for previous years are given for purposes of comparison.

TABLE IV.—Imports of Dates into the United Kingdom.

Country of Consignment.	1927.	1928.	1929.	1930.	1931.	1932.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Empire countries.. ..	2,307	1,652	1,202	17	12,640	520
Iraq	176,106	521,494	381,279	287,327	357,626	395,453
Persia	20,787	8,591	36,620	88,670	32,749	99,198
France	82,689	47,728	65,210	84,318	76,252	63,016
Algeria	7,579	31,081	22,183	13,554	7,202	3,715
United States	3,175	4,524	1,343	963	1,593	1,516
Other Foreign countries..	4,725	19,632	10,878	5,080	14,255	19,698
Total	297,368	634,702	518,715	479,929	502,317	583,116

Up to 1931, the imports of dates into the United Kingdom, though showing considerable fluctuations from year to year, tended to decline, but in 1932 there was a recovery to a total of 583,000 cwts., or 81,000 cwts. more than in the previous year.

Practically the whole of the imports of dates are consigned from foreign countries, and the supplies from Empire sources are of very small proportions. The principal producing country is Iraq, and between 60 and 80 per cent. of the annual supplies are obtained from there; in 1932, over 395,000 cwts. were received from Iraq, representing about 68 per cent. of the total. Imports from Persia are increasing in importance, amounting in 1932 to 99,000 cwts. Shipments from France consist mainly of re-exports of dates previously imported from French colonies, and amounted to 11 per cent. of the total, a lower proportion than usual, due to the small Algerian crop and the late harvest in that country.

The main importing season is from November to January, and hence fluctuations in the annual figures may frequently be explained by the earliness or lateness of the seasons in the various producing countries.

The re-export trade in dates is on a substantial scale, and usually accounts for about 40 per cent. of the imports, Canada and the United States being the principal countries to which consignments of imported fruit are made.

Unenumerated Dried Fruits

No direct information is available as to the different varieties included in the imports of dried fruits classified in the United

Kingdom trade returns as unenumerated, but apples, peaches, pears and fruit salad probably make up the greater part of the total.

Table V gives the quantities of unenumerated dried fruits imported into the United Kingdom, detailing the principal consigning countries, for each year from 1927 to 1932.

TABLE V.—*Imports of Unenumerated Dried Fruits into the United Kingdom.*

Countries whence consigned.	1927.	1928.	1929.	1930.	1931.	1932.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Union of South Africa ..	989	3,328	1,017	11,354	3,525	6,665
Australia	3	7,119	5,448	6,433	2,011	2,757
Canada	2,249	2,355	1,828	1,632	1,755	1,521
British West Indies ..	1,277	885	275	416	311	255
Other Empire countries ..	648	397	367	820	429	707
United States	34,521	39,176	31,097	23,811	37,354	30,791
France	5,363	7,990	13,377	11,583	8,015	12,808
Germany	391	1,736	1,290	125	358	21
Other Foreign countries..	3,024	4,056	2,059	1,913	1,313	3,070
Total Empire countries	5,166	14,084	8,935	20,655	8,031	11,905
Total Foreign countries	43,299	52,958	47,823	37,432	47,040	46,690
Total	48,465	67,042	56,758	58,087	55,071	58,595

During each of the past four years, imports of unenumerated dried fruits have shown little variation, and have been consistently between 55,000 and 60,000 cwts.

Imports in 1932 were slightly greater than in 1931, due principally to larger supplies from the Union of South Africa and France. Over four-fifths of this class of fruit is obtained from foreign countries and more than half is received from the United States, shipments from which country fell substantially in 1932. Consignments from the United States are mainly dried apples and fruit salad with smaller

quantities of peaches and pears. Imports from France are understood to be mainly dried apple pulp, which is a by-product of the cider industry. Shipments from the Union of South Africa consist mainly of peaches and pears, with smaller amounts of apples and nectarines, and those from Australia are chiefly peaches, while arrivals from Canada are principally apples. The quantities recorded as imported from the British West Indies, are mainly dried bananas from Jamaica.

Imports of this miscellaneous class of dried fruit are received in all months of the year, but are heaviest in November and December.

Imports of the various classes of dried tree fruits in each month of 1932 are shown in Table VI below, from which it will be noted that the bulk of the imports of figs and fig-cake is concentrated in the three months September to December, while November to January is the period of heaviest shipments of dates. The import season for prunes and apricots is not so well-defined, but November, December and January are normally months of heavy arrivals.

TABLE VI.—*Monthly Imports of Dried Tree Fruits into the United Kingdom in 1932.*

Month.	Figs and Fig-cake.	Plums, Prunes and Prunelloes.	Dates.	Un-enumerated.
	Cwts.	Cwts.	Cwts.	Cwts.
January	328	44,432	132,139	4,483
February	22	32,944	16,925	2,442
March	—	40,757	10,826	5,988
April	—	43,533	1,668	2,068
May	59	49,062	1,677	3,187
June	201	37,152	2,125	3,010
July	2	19,584	136	4,575
August	22	23,811	1,703	3,516
September .. .	28,406	26,909	2,917	3,226
October	53,111	32,917	55,087	5,750
November .. .	26,132	46,233	256,675	10,415
December .. .	5,671	58,902	101,238	9,935
Total	113,954	456,236	583,116	58,595

PRODUCTION AND EXPORTS OF AUSTRALIAN DRIED FRUITS

The dried fruit industry in Australia has made great strides in recent years, and development has been especially marked in the production of the dried vine fruits, viz., sultanas, currants and lexias. In view of the importance of these fruits it is convenient to consider them first, and to deal later with the much smaller output of dried tree fruits, such as apricots and prunes.

DRIED VINE FRUITS

Production

The production of these fruits has developed into an important industry in quite recent years. From the end of the war up to 1924 expansion was rapid, and the total crop of 895,000 cwts. in that year was nearly three times that of 1921. There was some reduction in the next two years, but in 1927 a new high point was reached with over 1,100,000 cwts. In the year 1928 frost damage to buds in the early spring resulted in a sharp decline to 640,000 cwts., but this was followed by two bumper crops, production in 1929 amounting to about 1,434,000 cwts., and in 1930 to 1,444,000 cwts., so far the record figure. Thus, in the space of ten years the production of dried vine fruits was more than quadrupled. Owing to unfavourable weather, a considerable decline occurred in the 1931 crop, which fell to just over 1 million cwts., or rather less than the 1927 level. There was a slight advance in 1932, but production was again much below the 1930 record.

All classes of fruit have shared in this upward movement, but the increase has been most apparent with sultanas, and least with lexias, which form the smallest proportion of the total. In 1930, the record year, sultanas represented about two-thirds of the total production, currants about one-quarter and lexias 8 per cent., the corresponding figures for 1926 being 56, 36 and 8 per cent., respectively. On the whole, the tendency in recent years had been for the proportion of sultanas to increase at the expense of currants, the small proportion of lexias remaining fairly steady. The year 1931, however, showed considerable variation from this trend; sultanas fell heavily and formed little more than half the total; the decrease in currant production was only slight and the proportion of the total rose to

35 per cent.; lexias showed an increase, the percentage advancing to 13. In 1932, sultanas again increased to 63 per cent., while currants fell to 30 per cent. and lexias to 7 per cent.

TABLE I.—*Production of Raisins and Currants in Australia.*

Description of Fruit.	1926.	1927.	1928.	1929.	1930.	1931.	1932. (a)
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Sultanas ..	387.7	769.2	389.2	921.5	949.1	527.9	730.0
Currants ..	252.7	228.7	143.5	379.7	378.1	349.6	340.0
Lexias ..	60.2	106.1	104.3	133.2	116.7	133.5	80.0
Total ..	700.6	1,104.0	637.0	1,434.4	1,443.9	1,011.0	1,150.0

(a) Provisional estimate.

It is estimated that the dried fruit crop in the present (1933) season will total 70,000 tons, including 50,000 tons of sultanas, 15,000 tons of currants and 5,000 tons of lexias. The quantities destined for the British markets are naturally dependent to a certain extent on the requirements of other markets, but it is anticipated that up to 30,000 tons of sultanas, 8,000 tons of currants and 2,000 tons of lexias will be shipped to this country. The large production of sultanas has been harvested under exceptionally good conditions, and the quality is reported to be very good.

Exports

The growth in production is reflected in the exports, which were nearly two and one-half times as great in the 1930-31 season as in 1926-27, increasing from 463,000 cwts. to 1,135,000 cwts. During this period all three fruits shared in the increase, which was relatively greatest for the light supplies of lexias, and smallest for currants. Owing to the crop shortage, there was a fairly sharp decline in 1931/32 from the previous season's high level, and only a partial recovery in 1932/33.

Total exports during each season (April to March) from 1927/28 to 1932/33 are shown in Table II.

TABLE II.—Exports of Dried Vine Fruits from Australia.

Fruit and Country to which consigned.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.	1932-33. (a)
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
<i>Sultanas.</i>						
United Kingdom ..	563.0	222.0	696.0	612.2	233.6	282.2
New Zealand ..	35.3	23.7	29.9	33.5	32.7	53.8
Canada ..	17.6	14.2	50.5	110.6	123.8	233.6
Other countries ..	2.3	2.5	8.2	11.4	12.9	7.3
Total ..	618.2	262.4	784.6	767.7	403.0	576.9
<i>Currants.</i>						
United Kingdom ..	95.1	11.7	248.8	261.3	209.4	190.0
New Zealand ..	9.7	9.3	10.4	8.9	13.1	11.8
Canada ..	37.2	44.0	30.8	31.2	43.1	44.3
South Africa ..	4.8	5.5	5.4	1.4	5.6	3.8
Other countries ..	4.2	3.3	4.6	3.8	4.5	5.9
Total ..	151.0	73.8	300.0	306.6	275.7	255.8
<i>Lexias.</i>						
United Kingdom ..	40.9	44.0	58.4	52.0	66.6	14.4
New Zealand ..	.2	.1	.2	.9	1.0	.9
Canada ..	13.2	3.0	12.0	6.9	12.0	13.7
Other countries ..	.4	.5	.6	.6	.9	.6
Total ..	54.7	47.6	71.2	60.4	80.5	29.6
Total—all fruits ..	823.9	383.8	1,155.8	1,134.7	759.2	862.3

(a) Provisional.

By far the greatest proportion of the exports comes to this country, which has taken increasing quantities in recent years. The proportion for sultanas averaged over 80 per cent. in the six seasons, 1926-27 to 1931-32 ; currants have shown greater fluctuations, and in 1928-29, owing to the maintenance of shipments to Canada out of a greatly reduced total export, the proportion sent to this country was well under 20 per cent., but the normal is about 80 per cent.

Between 80 and 90 per cent. of the exports of lexias regularly come to this market.

Apart from the yearly fluctuations due mainly to crop variations, exports to New Zealand remain fairly steady. But a striking increase has occurred in the exports to Canada, which has now become Australia's most important market after the United Kingdom; between the seasons 1926-27 and 1931-32 the proportion rose from 3 to 24 per cent.

Prices in the United Kingdom

Average prices realised in this country for Australian dried fruits based on the sales recorded with the London Agency of the Commonwealth Dried Fruits Control Board, from whose reports these figures have been extracted, are given in Table III. Details for the 1932-33 exporting season are not complete and figures have not therefore been included in the table, but up to the beginning of May the average price for sultanas was 54s. 7d., for currants 40s. 2d., and for lexias 32s. per cwt., showing in each case a slight reduction on the previous season.

TABLE III.—*Average prices per cwt. of Australian Dried Fruit in the United Kingdom.*

Fruit.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
Sultanas	64 7	53 9	35 2	38 8	41 10	57 6
Currants	37 10	42 7	55 7	42 7	35 0	41 6
Lexias	38 9	43 6	33 3	28 1	26 0	35 1

DRIED TREE FRUITS

Production.

Table IV shows official figures of production in the seasons 1924-25 to 1930-31, the latest period for which such details have been received.

TABLE IV.—*Production of Australian Dried Tree Fruits.*

Fruit.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Apples	8.0	8.5	8.0	13.6	6.4	11.6	3.4
Apricots	15.8	11.7	17.5	13.2	32.2	22.3	20.6
Peaches	8.5	7.0	5.2	11.7	9.4	9.6	8.1
Pears	3.5	3.4	2.1	3.8	3.5	4.7	3.2
Plums and Prunes	14.8	10.2	8.0	23.2	30.6	37.8	44.8
Nectarines .. ..	.3	.1	.6	1.0	1.4	1.2	.8
Other .. ..	.3	.5	.2	.2	.2	.3	.5
Total	51.2	41.4	41.6	66.7	83.7	87.5	81.4

The table shows that the production of dried tree fruits in Australia during the last three years for which particulars are available was considerably above the level of earlier years, but the total is still comparatively small. Prunes and plums, and apricots form the largest proportion; there has been a considerable expansion in the output of prunes and plums since 1925, but for apricots the increase has been on a much smaller scale.

Exports

Exports of dried tree fruits from Australia vary considerably from year to year, and although a substantial increase has been recorded in the past few years, they are still of comparatively minor importance. In the twelve months ended June, 1925, exports of dried apples, apricots, peaches, prunes and other dried tree fruits amounted to about 6,050 cwts. and by the year 1928-29 they had risen to 18,720 cwts., having fallen in the meantime (in 1926-27), as low as 640 cwts. There was a decline to 15,900 cwts. in 1929-30 and only a partial recovery to 17,800 cwts. in 1930-31, the last period for which official figures have been received, but over the seven years 1924-25 to 1930-31 the increase was considerable, exports in the latter year being nearly three times as heavy as in the former.

Apricots are normally by far the most important dried tree fruit exported and shipments, though fluctuating considerably from year

to year, are growing rapidly ; exports of peaches, the next most important item, also show marked expansion ; but although prune production forms a large proportion of the total output, prune exports are still on a low level, while shipments of apples are not yet material. The following were the total exports of the various fruits in 1930-31 with comparative figures (in brackets) for 1929-30 :— Apples, 170 cwts (140 cwts.) ; apricots, 8,940 cwts. (7,590 cwts.) ; peaches, 3,650 cwts. (3,500 cwts.) ; prunes, 1,370 cwts. (390 cwts.) ; and other fruits (including pears and nectarines 3,710 cwts. (4,230 cwts.).

No other country compares in importance with the United Kingdom as a market for Australian dried tree fruits. About 12,200 cwts. or nearly 70 per cent. of the exports came here in 1930-31 and of this total 8,700 cwts. consisted of apricots and peaches.

PRODUCTION AND EXPORTS OF SOUTH AFRICAN DRIED FRUITS

The fruit industry in the Union of South Africa has now reached considerable proportions, and its growth in recent years has been rapid. In 1921 the declared value of total exports of fruit and fruit products was about £730,000 and by 1931 the value had risen, in spite of declining prices to nearly £1½ millions. Fresh fruit which accounted for 80 per cent. of the value of total exports in 1931, is now by far the largest item, and expansion has been relatively greatest in this class, exports in 1931, amounting to approximately 3,900,000 boxes, being nearly five times as great as in 1921. Canned fruit, which accounts for only a small proportion of the total exports, showed only a small advance during the period, but dried fruit exports increased by about 40 per cent. So far only preliminary returns are available for 1932, and details for all classes of fruits were not included, but these figures indicated a further increase, the total value of exports, excluding canned fruits and miscellaneous fruit products, rising to just under £2 millions.

I.—PRODUCTION

Production of dried fruit in the Union of South Africa is shown in Tables I and II. The figures in Table I are the official statistics of the quantities of raisins, sultanas and currants sold off farms (exclusive of native production), and in Table II similar details are given for

dried tree fruits, with the addition of the total factory production in each year.

In the five seasons ending with 1929-30 there was not much expansion in the output of dried vine fruits, since, although the increase in the first two years of the period was fairly marked, the subsequent decline was of similar dimensions. Fluctuations in the output of raisins and sultanas have determined this movement, the small but increasing production of currants having little effect on the total. Official estimates for the 1930-31 season are not available.

TABLE I.—*Production of Raisins and Currants on Farms in the Union of South Africa.*

Fruit.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Raisins	53·6	60·5	60·6	58·6	53·6
Sultanas	27·9	31·4	36·1	30·1	26·8
Currants.. ..	1·6	1·9	1·7	3·8	5·5
Total—dried vine fruits	83·1	93·8	98·4	92·5	85·9

The development of the dried tree fruit industry has followed somewhat different lines. Regular alternations of light and heavy packs occurred in the four seasons up to 1928-29, but in 1929-30 production of these fruits totalled nearly 115,000 cwts. as compared with 74,000 cwts. in the previous crop year and 65,000 cwts. in the 1925-26 season. The production of the dried tree fruits is largely determined by the size of the crops and the state of the market for fresh fruits, and on this account yearly fluctuations are to be expected. The importance of this factor is probably greatest where apricots, peaches and pears are concerned.

Separate details of the different fruits comprising the total factory output are not available and it is, therefore, difficult to determine the trend of production in each case. But it seems evident that the packs of apricots and prunes have made substantial advances, while not much change has taken place in the production of the other fruits.

TABLE II.—*Production of Dried Tree Fruits in the Union of South Africa.*

Fruit.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apples	2·2	1·4	1·9	2·1	2·1
Apricots	9·6	17·5	19·8	23·5	24·6
Figs	2·3	2·5	1·9	2·4	3·0
Peaches	18·7	15·8	11·9	15·4	25·4
Pears	1·8	0·7	1·9	1·1	4·1
Prunes	12·1	18·8	5·2	12·2	33·5
Total farm production ..	46·7	(a)56·7	(a)42·6	(a)56·7	(a)92·7
Total factory production ..	18·1	18·5	13·8	17·3	21·8
Total	64·8	75·2	56·4	74·0	114·6

(a) Dried fruit sold

II.—EXPORTS

Up to 1930 only raisins, currants, prunes and figs were separately distinguished in the official annual trade returns; for 1931, however, apricots were separately enumerated, but currants were merged with raisins. Information regarding total exports of all dried fruits can also be obtained from the monthly returns published in "Crops and Markets" by the Union Department of Agriculture, and with the details in this publication some further indication can be given of the composition of the miscellaneous dried fruits, although particulars of the distribution of these exports are lacking. Total exports of dried fruits from the Union of South Africa in the six years, 1926 to 1931, the last year available, are shewn in Table III, and the supplementary details in regard to the unenumerated dried fruits in Table IV. In connection with Table III it should be noted that exports of dried fruit from the Union to Southern and Northern Rhodesia and to South-West Africa are not separately shewn in the South African trade returns except as an aggregate of all dried fruits combined.

A substantial proportion of the dried fruit produced in South Africa is exported, the average in the five years 1927 to 1931 being about 84,000 cwts. Until 1929 raisins (including sultanas) were the

largest item in the total, but in that year, and in 1930, they were exceeded by the exports of unenumerated dried fruits, which in most years consist very largely of dried apricots. In 1931, however, exports of raisins (including currants) increased substantially, making these fruits again the largest individual item. Exports of figs remained small, but there was an almost continuous rise in exports of prunes and unenumerated fruits in the five years 1926 to 1930, followed by a sharp decline in 1931.

TABLE III.—*Exports of Dried Fruits from the Union of South Africa in the years 1926 to 1931.*

Fruit and Country to which consigned.	1926.	1927.	1928.	1929.	1930.	1931.
<i>Raisins.</i>	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
United Kingdom ..	28,226	30,842	46,954	22,073	13,057	54,296
Canada	223	907	3,705	2,099	446	1,435
United States ..	13,910	—	58	—	—	—
Other countries ..	1,861	518	622	624	503	1,441
	44,220	32,267	51,339	24,796	14,006	57,172(a)
<i>Prunes.</i>						
United Kingdom ..	3,507	4,200	—	2,963	17,524	1,132
Germany	—	—	—	2,744	3,772	1,138
Other countries ..	107	300	233	191	303	199
	3,614	4,500	233	5,898	21,599	2,469
<i>Currants</i>	14	88	53	108	39	(b)
<i>Figs</i>	6	46	36	285	38	19
<i>Other Dried Fruits.</i>						
United Kingdom ..	13,049	14,320	17,012	22,295	48,401	18,941
New Zealand	5,385	9,251	8,777	4,824	7,229	5,987
Germany	801	1,776	471	6,968	1,191	4,392
Other countries ..	3,079	1,063	557	1,298	2,513	2,236
	22,314	26,410	26,817	35,385	59,334	31,556(c)
Trade with Southern and Northern Rhodesia and South-West Africa (all dried fruits) ..	4,427	5,235	5,150	5,663	4,884	6,321
Total exports ..	74,595	68,546	83,628	72,135	99,900	97,537

(a) Includes currants.

(b) Included in raisins.

(c) Apricots 27,269 cwts.

Preliminary figures of total exports given in the monthly returns published in "Crops and Markets" suggest a substantial increase in 1932, the aggregate rising to 124,280 cwts. made up as follows:— Raisins (including currants) 57,660 cwts.; prunes 13,830 cwts.; figs 160 cwts. and other dried fruits 47,350; and exports to Southern and Northern Rhodesia and South-West Africa 5,280 cwts.

The bulk of the exports of South African dried fruit comes to the United Kingdom which took 76 per cent. of the total in 1931, as compared with about 60 per cent. in 1926. Exports of prunes to this country in 1930, which were considerably greater than in the previous three years exceeded exports of raisins, but there was a great contraction in prune exports in 1931 while raisin exports were quadrupled. Miscellaneous dried fruits, mainly apricots, accounted in 1931 for 25 per cent. of the total exports to the United Kingdom.

The unenumerated dried fruits shown in Table III consist mainly of apricots and peaches with smaller quantities of pears, apples, nectarines and plums. Particulars of yearly exports of these fruits, taken, as previously mentioned, from the monthly returns issued by the Union Department of Agriculture are shown in Table IV for the past five years, but it should be noted that the monthly figures are provisional only, and this explains the discrepancies between the totals in this table and in Table III.

TABLE IV.—*Exports of Certain Dried Fruits from the Union of South Africa.*

Fruit.	1928.	1929.	1930.	1931.	1932.
	cwts.	cwts.	cwts.	cwts.	cwts.
Apricots	22,210	30,730	35,210	25,910	38,310
Peaches	2,210	3,420	11,250	2,880	6,320
Pears	780	—	2,720	660	2,110
Apples	420	200	650	630	210
Nectarines	20	—	80	110	100
Plums	—	—	100	40	140
Other dried fruits, excluding nuts	860	700	360	240	160
Total	26,500	35,050	50,370	30,470	47,350

It will be seen that dried apricots are every year the largest item, and that compared with these the other fruits included in the table are relatively unimportant. In four of the past five years apricots

have accounted for 80 per cent. or more of the total, and, although fluctuating from year to year, exports of this fruit have recently shown a distinctly upward tendency. Peaches are the next in importance, but show considerable variations in amount while shipments of pears and other fruits continue on a small scale, and show no definite evidence of an upward trend.

Details of the distribution of the exports of the separate items in the above table are available for apricots only, and the annual trade volume shows that of the total exports of 27,269 cwts. in 1931, 61 per cent. went to the United Kingdom, 18 per cent. to New Zealand, and 15 per cent. to Germany.

UNITED STATES PRODUCTION OF DRIED FRUITS

The dried fruit production of the United States is almost entirely concentrated in the Pacific Coast States. For all practical purposes the whole output of dried apricots, peaches and raisins is grown in California, while the combined packs of prunes in this State and in the States of Washington and Oregon represent the commercial production of the United States. With figs the position is somewhat different, but even here production on the Pacific Coast predominates; it is probable that at least three-quarters of the total dried figs produced in the United States are grown in California.

Production of Dried Fruits in the United States.

Fruit.	1927.	1928.	1929.	1930.	1931.	1932.(a)
	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.	Thousand tons.
Raisins	268	230	192	171(c)	151	225
Prunes	219	202	144	246(b)	213	174(d)
Apricots	22	20	20	21	33	29
Peaches	14	25	14	23	18	21
Pears	3	5	4	4	3	6
Figs	8	8	11	13	13	15(e)
Total	534	490	385	478	431	470

- (a) Estimates subject to confirmation.
- (b) Excludes about 19,000 tons (dried basis) not harvested.
- (c) Excludes about 73,000 tons (dried basis) not harvested.
- (d) Excludes 2-3,000 tons of Californian crop not harvested.
- (e) Includes 4,000 tons of non-merchantable quality.

The figures in the table have been compiled on this basis from various published sources. But in view of the exceptions noted above and because certain small packs for which comparable details are not available have been omitted, the yearly aggregates fall short of the actual total production for the United States. Dried apples are the most important omission and these have been excluded because reliable comparable figures cannot be obtained. Output in 1931, according to the Census, amounted to nearly 20,000 tons about 60 per cent. of which were produced in California.

The preliminary estimate of raisin production in 1932 indicates a substantial increase on the revised figure for the previous year and is the largest output since 1928. Prunes, however, showed an appreciable decline as did also the small pack of apricots, but the decreases in these packs were insufficient to offset the increase in raisins, and the aggregate for the items included in the table was, accordingly, about 9 per cent. larger than in the previous year.

The Californian Situation in 1932

The principal dried fruit crops displayed much the same characteristics as the canning crops, a further fall in values being general. The declines varied in intensity, according to estimates made by the California Crop Reporting Service, but on the whole the aggregate return for the main drying crops (apricots, peaches, raisin grapes and prunes) showed a smaller reduction over the previous year than was the case with the principal canning crops. Average farm values per ton for apricots fell by about 40 per cent. and for Freestone peaches the 1932 average was little more than half as great. The reduction for raisin grapes used for drying was slightly less at 35 per cent., while for prunes the average declined by only 10 per cent. The yield of peaches and raisins was greater than in the previous season, and this was no doubt an important factor in the decline, but the averages for apricots and prunes also fell although crops of these fruits were lighter. It is perhaps worth noting that the fall was least for prunes the only crop in which a control scheme was carried out.

Raisins

Plans for the control of the 1932 crop were completed early in the season. Under the new scheme raisin growers were released from previous contracts with the Raisin Pool, and a campaign was started to secure acreage for raisin tonnage on a ten year agreement, to be

effective if 85 per cent. of the acreage were covered. An essential feature of the new plan was the separation of the Raisin Pool from the Grape Control Board. But in spite of the fact that a larger crop was in prospect than in the previous year, and although the closing date of the sign-up campaign was extended to August 20th the acreage contracted to enter the Pool was far short of the minimum of 210,000 acres required and control had to be abandoned. The California Raisin Pool which had been in operation for several years was accordingly wound up and the stocks disposed of to packers.

The provisional estimate of the 1932 crop of raisin grapes places it at about 1,050,000 tons as compared with 692,000 tons in the previous year. About 150,000 tons were disposed of fresh or not utilised, leaving a balance of some 900,000 tons which gives an estimated yield of raisins (based on a conversion rate of 4 tons of fresh grapes to 1 ton of raisins) amounting to 225,000 tons. In addition stocks carried over from the previous season amounted to about 50,000 tons, and the disposal of the large quantities of old crop raisins when the Pool was wound up caused considerable dislocation of the market. Exports have been on a lower level than in the previous season, and although reports indicate an improvement in domestic consumption unsold stocks at the end of the season are likely to be substantial.

In view of the heavy production of raisin grapes in recent years and the efforts in various directions to restrict output the trend of acreage is of considerable interest. In 1926 the acreage reached its peak, according to estimates made by the California Co-operative Crop Reporting Service, and it is estimated that in that year 347,000 acres (bearing and non-bearing) were under raisin grape varieties in the State. By 1929 the total had shrunk to just under 298,000 acres (including about 900 acres not in bearing). There was a further marked decline in the following year to 248,000 acres (400 acres not bearing), but since then contraction has been slower, and the figure for 1932 is estimated at 240,000 acres, including 500 acres not in bearing.

Prunes.—The most important event of the year was the introduction of unified control in the prune industry by the formation of the United Prune Growers of California and the Californian Prune Pool. The scheme is essentially an attempt to substitute orderly marketing for the rather loose form of organisation which had developed in the industry.

The plan provided for the setting up of a new body known as the United Prune Growers of California which was to receive fruit from two groups (1) the California Prune and Apricot Growers' Association, (already in existence and controlling about 30 per cent. of the production), and (2) the California Prune Pool, a new co-operative society to consist of growers not already members of the Prune and Apricot Association. Two-thirds of the fruit owned by the members of these two bodies were to be delivered to the United Prune Growers. The balance (one-third) of the prunes produced by the Prune and Apricot Growers' Association were to be packed and marketed by the Association as in the past, while the remaining one-third of the prunes of the grower members of the Prune Pool was to be sold to commercial packers participating in the scheme. The fruit held by the United Prune Growers was to be offered to commercial packers at prices to be declared from time to time.

The plan thus left a third of the tonnage free to be handled at the start to provide money for current expenses without any price control other than that exerted by the two-thirds held in the control pool for the purpose of stabilising the whole. It was hoped in this way to avoid throwing the whole tonnage on the early market, and to bring about the disposal of the crop according to the capacity of the market. Prunes produced by growers not taking part in the scheme could be purchased by the commercial packers, but the United Prune Growers were to have an option on such fruit, either for purchase or for the withdrawal of off-grade fruit from the market. Finally it was provided that the entire tonnage including that purchased by packers from independent growers, should contribute to a general advertising programme for the industry.

Before this plan could become effective agreement to co-operate had to be secured from growers representing at least 85 per cent. of the tonnage. On this basis it was estimated that the quantity required was 170,000 short tons. This figure was subsequently reduced by agreement to 160,000 short tons, and after a three months' campaign and two extensions of the time limit the quantity needed to bring the plan into operation was secured by a narrow margin.

The working of the control was based on an average output of 200,000 short tons, and the smaller yield in 1932 was therefore favourable to the operation of the plan in its first year. Final figures have not yet been issued, but the official preliminary estimate places the crop at about 176,000 short tons (dried basis). The considerable contraction in exports, and particularly the lack of

demand from Germany has caused some concern, but this, it is understood, has to a certain extent been compensated by a slightly better movement to domestic markets especially during the early part of 1933. The campaign to secure the minimum 80 per cent. tonnage needed to continue the operation of the plan for the 1933 crop is reported to have been successful.

EXPORTS OF DRIED FRUITS FROM THE UNITED STATES

(i) 1931-2 Season.

Although the first shipments of the new season's pack commence later in the year for many fruits, the season may conveniently be taken as running from July to June. The export figures for the twelve months ending June, 1932, reflect fairly closely the trend of the 1931 production, particularly as regards raisins, prunes and apricots, which normally account for the bulk of the total dried fruit pack of the United States.

Total exports of dried fruits for the 1931-32 season (July to June) amounted to 4,181,000 cwts. as against 4,610,000 cwts. in 1930-31, a decline of 9 per cent. Prunes, the principal item, decreased by 467,000 cwts. or 18 per cent., and apples, pears and raisins also declined, while peaches maintained the level of the previous season. Exports of apricots, of which the pack was much larger than in the previous year, increased by 59 per cent. and fruit salad and the miscellaneous varieties also advanced. Details for the 1927-28 to 1931-32 seasons are shown in Table I.

TABLE I.—Exports of Dried Fruits from the United States.

Fruit.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
Apples	193·8	446·9	212·2	340·4	280·9
Apricots	211·5	220·1	170·5	211·1	335·9
Peaches	58·5	111·0	34·3	75·8	75·8
Prunes	2,327·0	2,438·0	1,276·7	2,645·1	2,178·0
Pears	(a)	(a)	32·6	71·8	54·3
Fruit salad ..	(a)	(a)	(a)	129·6	138·9
Raisins	1,724·1	1,980·4	1,148·1	1,116·9	1,091·2
Other dried fruits	178·0	209·3	107·2	19·5	26·2
Total	4,692·9	5,405·7	2,981·6	4,610·2	4,181·2

(a) Included in "Other dried fruits."

During each of the first three months of the 1931-32 season, exports of dried fruits were exceedingly heavy, and the total for the period July to September was 62 per cent. greater than the corresponding period for the 1930-31 season, but in October which is the first month of the heavy shipments of prunes, the increase was only slight, and the percentage for the four months had fallen to 23. From November onwards exports remained much below the previous season's figures, and the total for the five months ended November was no more than 4 per cent. in excess of the previous year, while for the half-year ended December there was a decline of 4 per cent. which had increased to 12 per cent, by the end of March. During April the decline in exports was slight only, and in May and June shipments were in excess of last year. The season thus closed with a total for the complete 12 months, 9 per cent. below that for the 1930-31 season.

Prior to July 1932, details of the destinations of the monthly exports of dried fruits from the United States were available only for apricots, prunes and raisins, and particulars of these for the periods July to June 1930-31 and 1931-32 are given in Table II.

TABLE II.—*Exports of Dried Apricots, Prunes and Raisins from the United States to various countries—July to June.*

Country.	Apricots.		Prunes.		Raisins.	
	1930-31.	1931-32.	1930-31.	1931-32.	1930-31.	1931-32.
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
United Kingdom ..	11.1	25.0	355.7	381.8	359.8	432.6
Belgium	17.2	17.8	85.8	59.3	24.7	25.8
Netherlands ..	26.2	35.0	168.6	83.2	78.7	65.3
Germany	77.8	105.2	871.6	559.1	130.6	150.9
Sweden	7.5	10.3	77.9	78.4	93.8	76.5
France	(a)	(a)	415.9	416.7	29.5	31.3
Denmark	20.4	30.1	82.5	71.2	12.3	16.3
Italy	(a)	(a)	141.5	118.4	(a)	(a)
Other European Countries	36.2	88.2	191.7	178.4	28.8	44.0
Canada	9.2	16.8	146.9	153.2	204.3	130.2
Other Countries ..	5.5	7.5	107.0	78.3	154.4	118.3
Total	211.1	335.9	2,645.1	2,178.0	1,116.9	1,091.2

(a) Included (if any) in "Other European Countries."

Germany is usually by far the most important market for prunes, and in the 1930-31 season took 33 per cent. of the total exports. During the 1931-32 season, however, shipments to that country were reduced by 312,000 cwts., or 36 per cent., and its proportion of the total fell to 26 per cent. On the other hand, exports to France, although heavily reduced in the last few months of the season following the higher rate of tariff imposed on imports of prunes, were maintained at their previous level, and over the whole season exports to France amounted to 19 per cent. of the total, against 16 per cent. in the previous season. Shipments to most of the other important European markets were severely reduced, and exports to the Continent as a whole fell from 2,040,000 cwts. in 1930-31 to 1,560,000 cwts. in 1931-32. Consignments to the United Kingdom increased slightly and the proportion taken rose from 13 per cent. to 18 per cent.

The United Kingdom is the most important market for United States raisins, and exports to this country in 1931-32 were 73,000 cwts. larger than in the 1930-31 season in spite of a slight decline in the total to all countries, the percentage of total exports increasing from 32 to 40. In 1930-31 Canada occupied the second place, but fell to third position in 1931-32, and Germany, which slightly increased its consumption, became the chief market, other than the United Kingdom.

Germany was the principal country to which dried apricots were consigned during the 1931-32 season, but substantial quantities were shipped to other European countries and the Continent as a whole took nearly 85 per cent. of the total exports to all destinations as compared with 88 per cent. in the previous season. The quantity exported to the United Kingdom though double that of the previous year, was comparatively small, and amounted to only 7 per cent. of the total.

Although for reasons already explained particulars of the distribution of the exports of fruits other than apricots, prunes and raisins cannot be given by seasons, figures for the calendar years up to 1931 have been published, and these afford an indication of the importance of the different markets. Total exports of each fruit, and exports to the United Kingdom for the years 1928 to 1931 are shown in Table III, which also includes total exports for the year 1932.

TABLE III.—*Exports of certain Dried Fruits from the United States in the calendar years 1928-1932.*

Fruits.	1928.		1929.		1930.		1931.		1932.
	U.K.	Total.	U.K.	Total.	U.K.	Total.	U.K.	Total.	Total.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
Fruit salad(<i>a</i>) ..	—	—	—	—	4.5	89.7	8.4	149.4	129.6
Pears(<i>b</i>) ..	—	—	1.6	40.9	9.2	59.0	10.8	66.5	52.4
Apples ..	21.4	313.3	15.8	338.3	13.8	267.3	20.6	324.6	282.4
Peaches ..	8.5	87.6	6.0	69.5	4.3	59.3	7.5	83.9	65.5
Other dried fruits	19.0	198.2	4.5	121.1	0.8	31.9	0.3	26.0	19.6

(*a*) Included in "Other dried fruits" prior to 1930.

(*b*) Included in "Other dried fruits" prior to 1929.

The table shows that the United Kingdom is not an important market for these fruits, the bulk of which goes regularly to Sweden, Germany, France and the Netherlands. In 1931 the United Kingdom took less than 6 per cent. of the exports of fruit salad, while 69 per cent. went to Sweden, and nearly 13 per cent. to Germany. The bulk of the pears was consigned to Germany and France, the United Kingdom's share amounting to about 16 per cent. Germany, France, Sweden, and the Netherlands, regularly import substantial quantities of dried apples from the United States and these four countries accounted for 82 per cent. of the 1931 total, while exports to this country amounted to only 6 per cent. The most important markets for the small exports of dried peaches are Germany, France and Canada to whom 55 per cent. were consigned in 1931; annual exports to this country average about 7,000 cwts. Exports to this country of the small balance of unclassified dried fruits are negligible; in 1931 Canada was the largest importer.

(ii) *Exports in the first half of the 1932-33 season (July to December, 1932).*

Total exports for the first six months of the 1932-33 season (commencing July) amounted to 2,390,000 cwts. as against 2,818,000 cwts. in the corresponding period of 1931, a decline of 15 per cent. With the exception of a slight increase in apples all fruits decreased, prunes, the principal item, falling by over 300,000 cwts.

Details of exports in the months of July to December, with comparative figures for 1931, are given in Table IV.

TABLE IV.—*Monthly Exports of Dried Fruits from the United States.*

Month.	Apples.		Apricots.		Peaches.		Prunes.	
	1931.	1932.	1931.	1932.	1931.	1932.	1931.	1932.
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
July	2.2	8.2	41.4	34.6	0.7	1.1	79.9	58.8
August.. ..	9.4	12.3	117.8	90.7	5.9	1.5	113.7	106.2
September ..	13.9	15.9	45.7	39.8	18.1	15.7	128.3	121.6
October	73.2	62.4	27.8	26.8	15.1	12.3	542.8	330.6
November	58.7	62.7	19.4	18.9	11.6	8.2	247.1	214.9
December	34.3	31.7	20.0	21.2	6.3	8.6	194.4	173.0
Total (6 mos.)	191.7	193.2	272.1	232.0	57.7	47.4	1,306.2	1,005.1
	Pears.		Fruit Salad.		Raisins.		Other Dried Fruits.	
July	0.6	0.5	3.6	1.3	59.0	31.1	1.5	1.0
August.. ..	0.2	0.3	2.1	1.1	70.6	13.8	1.2	0.5
September ..	4.2	4.4	1.5	10.7	177.4	137.8	2.9	1.7
October	18.6	13.8	76.8	53.7	320.1	421.4	4.7	2.3
November	9.6	9.1	8.0	8.9	140.9	106.7	3.9	3.8
December	5.3	8.6	5.5	12.6	66.5	63.2	5.8	4.1
Total (6 mos.)	38.5	36.7	97.5	88.3	834.5	774.0	20.0	13.4

The distribution of the exports in the first six months of the 1932-33 season (July to December) of apricots, prunes and raisins are dealt with separately in Table V. because comparable data are available for the same period in the previous year. The remaining fruits for which similar information was only published from July, 1932 onwards, are considered later.

practically represent the exports for the season. At this time a considerable quantity of fruit from the large 1932 crop remained to be shipped, and it may be that the figures given will require some upward revision, though in view of the heavy exports in the early part of the season the additions which may have to be made will probably not be heavy.

Smyrna Raisin Crop and Distribution

Year.	Crop.	Shipments.				Retained in Turkey.
		United Kingdom.	Continent.	Other Destinations.	Total.	
	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.	Thousand cwts.
1926-27 ..	680	242	316	22	580	100
1927-28 ..	980	232	538	30	800	180
1928-29 ..	1,020	234	556	58	848	172
1929-30 ..	1,180	186	602	50	838	(a)342
1930-31 ..	686	144	468	32	644	42
1931-32 ..	502	114	340	26	480	22
1932-33 ..	(b) 1,200	405	617	20	(c) 1,042	158

(a) Including a considerable quantity of rain damaged fruit.

(b) Estimated.

(c) Up to May 13th, 1933.

The production of raisins in Smyrna after the war was at a comparatively low level, the average for the five years 1920-24 dropping to 750,000 cwts. as compared with an average of 940,000 cwts. in the quinquennium 1909-13. After 1924 there were some seasons of good crops and the average for the period 1925-29 rose to 880,000 cwts., but this figure takes into account the record crop of 1929, which included a considerable quantity of rain-damaged fruit not used for export. The 1930 crop fell well below the level of the preceding years, and this was followed in 1931 by the smallest crop since 1918. In 1932, however, the yield of over 1,200,000 cwts. according to preliminary estimates, was nearly two and a half times as heavy as in the previous year, and is likely to prove a record.

The most notable feature in the post-war export trade in Smyrna raisins is the change which has taken place in the direction of exports. Until 1924-25 the United Kingdom was the leading market for this fruit, but in that season the proportion sent to this country fell to 26 per cent. or half that of the previous season, while the proportion of the total going to Continental markets, of which Germany was the most important, increased from just under 40 per cent. to nearly 60 per cent. A larger percentage came here in 1926-27, but the average for the next five seasons was 25 per cent. Total exports in the present (1932-33) season have been on an exceptionally heavy scale, and the United Kingdom has taken a higher proportion (nearly 40 per cent. of the total in the period up to May 13th, 1933), but this increase is probably exceptional, arising mainly from the fact that shipments in the first three months of the season were abnormally large in anticipation of the imposition of increased duties in this country in November. Since then imports into this country from Turkey have been below normal.

GREEK CURRANT PRODUCTION AND EXPORTS

Although only provisional estimates of the 1932 crop are so far available it is fairly certain that production will prove to have been the largest since 1928. This can be seen from Table I, giving production of Greek currants in the past five years.

TABLE I.—*Greek Currant Production.*
(In thousand cwts.)

1928.	1929.	1930.	1931.	1932. (a)	Yearly Average.	
					1922-26.	1927-31.
2,857	2,561	2,625	1,316	2,660	2,775	2,377

(a) Provisional estimate.

Following the light 1931 crop, exports of currants from Greece in the 1931-32 season continued the decline of recent years, the total of 1,474,000 cwts. (gross) showing a reduction of 15 per cent. on the previous season. Some improvement seems likely in the season now in progress, though shipments have not been much heavier than in

1931-32, although the 1932 crop was much greater. In the eight months, September to April, exports totalled 1,446,000 cwts. as compared with 1,305,000 cwts. in the same period a season earlier. By the end of April, according to a statement issued by the Central Currant Organization, about 110,000 tons (net) of the 1932 crop had been disposed of, 61,000 tons (net) by export, and the rest absorbed in retention or accounted for by retention warrants in circulation or by fruit in bonded warehouses against cash advances. With a crop of 130,000-140,000 tons this leaves roughly 30,000-40,000 tons, and it was considered doubtful whether, in view of the absence of demand, more than 7,000-8,000 tons would be exported.

The exporting season runs from September to August and shipments for recent seasons are shown in Table II, which includes comparative figures for the 1913-14 season. It should be noted that these figures represent gross weights and include small quantities of sultanas.

TABLE II.—*Shipments of Currants in the Seasons 1913-14 and 1928-29 to 1932-33.*

Country to whence consigned.	1913-14.	1928-29.	1929-30.	1930-31.	1931-32. (a)	1932-33. (b)
	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.	Thou- sand cwts.
United Kingdom	1,516.4	1,116.8	1,022.3	1,134.3	1,029.3	1,024.1
United States and Canada	380.8	94.4	90.9	91.8	54.8	56.3
France	27.6	—	—	9.3	5.1	6.5
Belgium	34.6	3.0	5.9	3.4	1.1	1.6
Holland	452.0	224.7	257.5	304.1	213.6	219.7
Germany	184.2	133.1	126.8	134.7	119.0	96.2
Other countries	115.3	54.1	53.3	59.8	51.3	41.8
Total	2,710.9	1,626.1	1,556.7	1,737.4	1,474.2	1,446.2

(a) Subject to adjustment.

(b) To April 30th, 1933, only.

The United Kingdom is the most important market for Greek currants, and although the quantity imported shows a declining tendency the proportion of the total, which is higher than in the year before the war, has not varied greatly in the past four years. In the seasons 1929-30 and 1930-31 about 65 per cent. of the total was exported to this country as compared with about 70 per cent. in the two previous seasons, but last season (1931-32) the proportion was

again 70 per cent. ; for 1913-14, however, the proportion was about 56 per cent. Holland and Germany are next in importance but France and Belgium take comparatively small quantities. Exports to the United States and Canada are declining, as would be expected in view of the large Californian production of dried fruit, and the importance of Canada as a market for Australian currants.

PRODUCTION AND EXPORTS OF SPANISH RASINS

During the four years 1928 to 1931, combined production of raisins in Valencia and Malaga, the two main producing regions of Spain, consistently declined. Production in both areas shared the decline, but the fall was relatively greater in the Valencia crop. The total output in the 1928-29 season was about 20,000 tons ; in the following season there was a slight fall to 19,800 tons, but in 1930-31 the total declined sharply to 15,600 tons, and was followed by a further fall to 14,500 tons in the 1931-32 season. This decline has been arrested. Crops in both areas in 1932 were better than in the previous year and there was an increased output of both Valencia and Malaga raisins in the 1932-33 season, as compared with the previous season. Exports from both areas already aggregate 16,500 tons, and stocks at Malaga are estimated at 1,350 tons, making the combined crop little short of 18,000 tons.

In the following paragraphs each region is considered separately.

Valencia Raisins

Weather conditions in the Valencia district during the development of the 1932 crop, although not entirely favourable, were better than in the previous year, and a larger crop was obtained. The total output of raisins in the 1932-33 season amounts to 8,200 tons, as compared with 7,765 tons in the previous season.

Although the decline in more recent seasons has been checked, the present output is considerably below that of earlier seasons. In recent years, however, considerably larger quantities of grapes are reported to have been marketed fresh than was formerly the case, and a correspondingly smaller proportion of the crop has been dried.

The United Kingdom continues to be the principal market for Valencia raisins, and, in spite of reduced crops, shipments in recent seasons have been maintained at about 5,000 tons. The proportion of the total crop exported to the United Kingdom increased from 40 per cent. in the 1928-29 season to 66 per cent. in the 1932-33

season. Shipments to the Continent showed a substantial fall as compared with recent seasons, mainly owing to a heavy decline in exports to Italy, but the home market took a considerably larger quantity than in the previous two seasons.

Table I gives comparative figures of exports, including consignments to home markets of the Peninsula, in the past four seasons.

TABLE I.—*Distribution of Raisins from the Valencia District.*

Destination.	Season 1928-29.	Season 1929-30.	Season 1930-31.	Season 1931-32.	Season 1932-33.
	Tons.	Tons.	Tons.	Tons.	Tons.
London	2,935	2,974	3,243	2,786	3,220
Liverpool	641	694	893	842	946
Bristol	488	528	445	531	532
Manchester	225	362	293	300	292
Cardiff	77	130	125	144	178
Other United Kingdom Ports	56	59	47	100	71
Ports in Ireland	250	258	261	202	168
Total to Great Britain and Ireland	4,672	5,005	5,307	4,905	5,407
France	757	652	702	508	547
Italy	1,028	353	616	750	272
Finland.. .. .	936	808	500	460	458
Norway.. .. .	144	247	228	334	259
Belgium	46	144	135	123	128
Other Continental Countries	58	109	65	52	40
Total to Continent ..	2,969	2,313	2,246	2,227	1,704
Algeria	582	615	381	235	305
U.S.A.	156	146	125	84	85
Canada	120	124	126	48	23
Newfoundland	39	44	35	15	13
Other Countries	95	196	165	64	89
Total to Other Destinations	992	1,125	832	446	515
Total Exports Overseas	8,633	8,443	8,385	7,578	7,626
Home Markets	3,087	2,529	245	187	566
Total	11,720	10,972	8,630	7,765	8,192

The export figures appear to indicate that European markets are at present unable to absorb much more than about 7,000 tons of Valencia raisins. There are, moreover, no present signs of any development in other overseas markets, and the only outlet for any increase in present production appears to be the home market.

Malaga Muscatels

There was a substantial recovery in the production of muscatels in the Malaga district of Spain in the 1932-33 season, from the low level to which it had fallen in recent years. Complete figures for the present season are not yet available, but up to the end of April exports totalled 8,300 tons, as compared with less than 7,000 tons in each of the two previous seasons. Stocks unsold are estimated at 1,350 tons.

TABLE II.—*Distribution of Dried Muscatels from Malaga.*

Destination.	Season 1928-29.	Season 1929-30.	Season 1930-31.	Season 1931-32.	Season 1932-33. (a)
	Tons.	Tons.	Tons.	Tons.	Tons.
United Kingdom	1,532	1,470	1,572	1,644	1,712
France	1,425	1,140	1,510	1,581	1,848
Netherlands	236	225	281	266	381
Belgium	448	316	252	299	258
Sweden	331	317	283	375	398
Germany	295	320	361	255	323
Denmark	178	125	133	169	113
Italy	195	85	86	57	56
Portugal	93	77	68	50	65
Norway	43	60	63	71	81
Other European Countries ..	24	30	21	32	27
Total to Europe ..	4,800	4,165	4,630	4,799	5,262
Central and South America..	940	984	555	512	579
U.S.A.	395	203	291	279	311
Canada	168	112	98	113	72
Other Countries	30	39	16	14	28
Total to Other Destinations	1,533	1,338	960	918	990
Total Exports Overseas ..	6,333	5,503	5,590	5,717	6,252
Home Markets	2,133	3,252	1,405	1,011	2,065
Total	8,466	8,755	6,995	6,728	8,317

(a) Up to the end of April, 1933.

The United Kingdom and France continue to be the principal markets for Malaga muscatels, and exports to these two countries have steadily increased in the last few seasons. Shipments to other European countries and to other destinations have not varied considerably, but the home market has taken increased quantities in the present season, as compared with the two previous seasons.

In order to facilitate the disposal of the present season's relatively large crop the Spanish Government took considerable quantities for distribution to the Army and other Government Institutions, a Raisin Exchange has been established at Malaga to deal with questions relating to the sale and distribution of the fruit, and throughout the season there has been active propaganda with the object of increasing home consumption.

E.M.B. 70.

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THE DEMAND FOR SOUTH AFRICAN DECIDUOUS FRUITS

Report of an Investigation by the Statistics and Intelligence
Branch of the Empire Marketing Board into the
Retail Marketing of South African
Deciduous Fruit



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THE DEMAND FOR SOUTH AFRICAN DECIDUOUS FRUITS

I. INTRODUCTION

1. In June, 1931, the Empire Marketing Board in conjunction with the South African Co-operative Deciduous Fruit Exchange, arranged to carry out a comprehensive survey of the marketing of deciduous fruit in the United Kingdom. In view, however, of the subsequent restriction of the Board's financial resources it was found necessary to revise the plan of the survey and the investigation which was carried out in the following season, though complete in itself, was restricted in scope, particularly in regard to the areas covered and the number of shops visited.

2. This survey is the eighth in the series dealing with the retail demand for Empire food products, others having dealt with cheese, butter, canned fruits, honey and canned vegetables. The investigation consisted of two distinct parts carried out concurrently between January and April, 1932. One part, in which cards were inserted in the fruit boxes at Southampton, to be completed and returned to the Board by the ultimate buyer, was designed to ascertain the condition as to ripeness and wastage of the fruit, on reaching the retailer. The other part was a survey of retail marketing by personal visits to retailers, on lines similar to those followed in earlier surveys in this series.

3. In the course of the first part of the enquiry nearly 22,000 cards were inserted, spread over 18 consecutive weekly shipments. Unfortunately, only a relatively small proportion of these were returned to the Board, and although a good deal of useful information, which has been summarised below, was obtained, the results would have been far more satisfactory if more retailers or other purchasers, had

acceded to the Board's request that they should furnish the few particulars required. The retail survey which extended over twelve weeks beginning in January, 1932, was carried out in London, Glasgow, Birmingham and Liverpool, and during this period 865 shops were visited. As explained in greater detail in the report this survey was conducted in two sections, each occupying six weeks, the first dealing mainly with peaches, plums and nectarines, and the second with pears and grapes, each shop thus being visited twice. This method was adopted because the seasons for these groups of fruits do not coincide, and because, in dealing with so seasonal a commodity as South African fruit, it was necessary to compress as many visits as possible into a short space of time. As in all the retail surveys conducted by the Board every reasonable care has been taken to ensure that a representative sample of shops has been visited, and in view of the experience in selection now gained by the investigators it is believed that a fair cross-section of the retail trade has been covered by this enquiry. The task of selection would, however, be much easier, and the sample of shops visited possibly more accurate, if reliable information on the number of shops, classified according to type and other particulars, were available for each area.

4. In carrying out this investigation the Board's officers received, as usual, the generous assistance of retailers and other members of the trade, and acknowledgment and thanks are here given to those whose help was so willingly afforded.

II. THE SUPPLY POSITION

5. Annual imports of peaches, plums, pears and grapes, the fruits with which this enquiry was mainly concerned, have fluctuated considerably in the past six years, and the prevailing tendency for peaches and grapes has been definitely upward. On the other hand plums, imports of which form only about a quarter of the total available supplies of that fruit, remain more or less stationary and have not, in subsequent years, reached the high level of 1927, while imports of pears, though increasing substantially in 1931, have consistently remained below the 1926 level; on the average about one-third of the total supplies of pears are home-grown.

The following table shows total annual imports in the years 1927 to 1932 with imports from South Africa during the period.

TABLE 1.—*Annual Imports of certain Deciduous Fruits, 1927–32*

Variety of Fruit.	1927.	1928.	1929.	1930.	1931.	1932.
	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.	000 cwts.
Peaches— <i>Total</i>	37	31	37	51	94	100
<i>South Africa</i> ..	21	11	19	26	20	30
Plums— <i>Total</i>	597	480	505	389	513	344
<i>South Africa</i> ..	18	15	17	27	29	32
Pears— <i>Total</i>	1,077	860	1,078	1,029	1,237	1,113
<i>South Africa</i> ..	35	101	24	108	40	92
Grapes— <i>Total</i>	718	840	864	695	944	905
<i>South Africa</i> ..	50	44	49	48	59	68

It can be seen from Table 1 that imports from South Africa, though fluctuating from season to season have, on the whole, increased substantially, the increase being particularly marked in the record figures for 1932. In the 1932 season the quantities of peaches and plums taken by the United Kingdom were four times as great as in 1926, grape imports were more than twice as large, while pears showed an increase of nearly 50 per cent.

6. Imports from South Africa arrive between December and May, a season which is especially favourable from the point of view of competitive supplies, at least as regards peaches and plums. Pears and grapes are, however, in most seasons in a much less fortunate position, and are subjected to competition from a number of countries both Empire and foreign.

Peaches

7. In the five years 1926 to 1930 imports from South Africa averaged 45 per cent. of the aggregate yearly imports, which practically represent total supplies, Home production being negligible. In 1931, however, supplies from Italy increased substantially raising the proportion of the total received from this source to over 60 per cent. as compared with about 40 per cent. in the previous year.

8. But these large supplies do not compete with the South African fruit since there are two distinct seasons for peaches, one in the winter months, from December to March, when South African supplies predominate, and the other from July to October when Italy is the chief source of imports. In the winter season South African fruit experiences very little competition as the figures in Table 2 show.

TABLE 2.—*Monthly Imports of Peaches during Winter Season 1931-32*

Month.	South Africa.	United States.	Argentina.	Total.
	cwts.	cwts.	cwts.	cwts.
December, 1931	803	166	—	969
January, 1932	10,007	—	—	10,007
February	16,819	—	45	16,864
March	1,921	—	136	2,057
Total	29,550	166	181	29,897

Plums

9. Though still a small percentage of total annual imports, which come mainly from the Continent and North America during the period June to October, South African plums arrive at a time when the market is practically bare of other supplies, including the large Home crop which forms on the average about three-quarters of the quantity available each year. Imports in the 1931-32 season are shown in Table 3.

TABLE 3.—*Monthly Imports of Plums during Winter Season 1931-32*

Month.	South Africa.	Australia and New Zealand.	Argentina.	Total.
	cwts.	cwts.	cwts.	cwts.
December, 1931	633	—	—	633
January, 1932	12,183	—	—	12,183
February	9,422	—	48	9,470
March	9,620	140	537	10,297
April	27	—	3	30
Total	31,885	140	588	32,613

Pears

10. Imports of South African pears account for about 4 per cent. of the total annual supplies, including the Home crop which averages about 30 per cent. of the aggregate. In recent years imports of pears have been more evenly distributed over the year, but more than half still arrive during the months of August to October, when supplies are coming from the Continent and the United States.

11. South African pears arrive from February to April inclusive and are in competition with supplies from the United States and South America as well as from Australia and New Zealand. In January and February heavy imports are arriving from the United States, and while these fall away at about mid-season, Australian and New Zealand pears begin to arrive in large quantities before the end. For the first five months of 1932 South African pears accounted for 31 per cent. of the total imports, while those from Australia and New Zealand amounted to 45 per cent. Figures are given in Table 4.

TABLE 4.—*Monthly Imports of Pears, January–May, 1932*

Month.	South Africa.	United States.	Brazil and Argentina.	Australia.	New Zealand.	Total.
1932	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	255	37,108	—	—	—	37,363
February ..	20,483	16,239	2,177	938	—	39,837
March ..	43,364	2,709	9,453	8,709	33	64,268
April ..	25,141	840	4,549	24,364	9,325	64,219
May ..	2,323	282	602	64,165	24,555	91,927
Total ..	91,566	57,178	16,781	98,176	33,913	297,614

Grapes

12. About 90 per cent. of the average annual supplies of grapes in this country come from foreign countries, chiefly Spain, but although South Africa supplies only an average of 6 per cent. of the total for the year, grapes from this source represent well over half of the total supplies during the four months when they are on the market. Imports normally begin to arrive in February, appearing at a time when imports from Spain cease and imports from Belgium are

declining. But during the course of the season South African grapes are in competition with supplies from Argentina, Australia and the United States, as Table 5 shows.

TABLE 5.—*Monthly Imports of Grapes, January to May, 1932*

Month.	South Africa.	Spain.	Belgium.	Argentina.	U.S.A.	Australia.	Total.
1932	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	—	9,629	3,610	—	2,585	—	15,824
February ..	4,666	67	2,296	—	2,714	—	9,743
March	24,014	113	784	1,478	3,323	1,749	31,461
April	20,233	—	248	7,632	—	3,918	32,031
May	15,044	—	276	6,406	—	3,231	24,957
Total ..	63,957	9,809	7,214	15,516	8,622	8,898	114,016

III. ENQUIRY INTO THE CONDITION OF THE FRUIT ON REACHING THE RETAILER

13. The method adopted in this investigation was as follows. Cards were inserted in boxes of fruit at the ports and the retailer who opened the box was asked to return the card to the Board stating the date upon which the box was opened, the condition of the fruit, and any other information which might be considered useful. The insertion of cards went on throughout the season and nearly 22,000, covering 18 consecutive weekly shipments, were distributed. Efforts were made to ensure that the cards were spread evenly over all varieties and grades of fruit. The following table shows the number of cards inserted and the number returned.

TABLE 6.—*Summary of Card Enquiry*

Fruit.	No. of Shipments.	Cards Inserted.	Cards Returned.	Percentage Returned.
Peaches	9	3,121	317	10
Plums	12	4,986	369	7
Pears	18	6,160	410	7
Grapes	17	7,694	660	9
Total	—	21,961	1,756	8

14. Cards were received from all parts of the United Kingdom and also from Holland, Belgium, France, Germany, Denmark, Norway and Sweden. In all, 59 cards were received from the Continent. The low proportion, only 8 per cent., of cards returned is disappointing, and it seems that retailers do not fully appreciate the value, to growers and exporters, and ultimately to the trade in this country, of the information they were asked to supply through this medium. But it should be added that a number of retailers expressed approval of the inquiry, and a better response will perhaps be forthcoming should this method be used in future investigations.

15. This was the first occasion on which this method of investigation was used on any considerable scale by the Board. In general the results indicated that a great deal of useful information might be obtained regarding, for example, the keeping properties of different varieties of fruit, particularly if a larger percentage of returned cards could be ensured.

The following is a summary of the results of the inquiry :—

Peaches

16. The peach season opened in January and continued until the beginning of March. Retailers were asked to state whether they found the fruit (*a*) unripe, (*b*) ripe for eating, (*c*) over-ripe. Of the replies received 10 per cent. fell into category (*a*), 85 per cent. into category (*b*), and 5 per cent. into category (*c*). The time elapsing between the arrival of the fruit at the port and the opening of the box in the retail shop varied from one to 30 days, but the majority of boxes was opened in about 8 days.

17. The fruit was generally well received and 42 per cent. of the cards returned bore very favourable comments upon its condition and quality. There were a few complaints of bruising through insufficient packing, chiefly of the larger-sized fruits. Of fifteen boxes which were not opened until three weeks or more after leaving the port of arrival, only two were reported to contain over-ripe fruit.

Plums

18. For plums the period which elapsed before boxes were opened varied from 2 to as much as 46 days. A very large number of boxes of Kelsey plums was not opened for more than a fortnight after leaving the ship and a considerable quantity for three weeks or more.

Yet the proportion of over-ripe fruit reported in these latter cases was no higher than the average for the whole of the plums for which reports were received. Besides the Kelsey variety, Wickson plums had also been kept for periods up to more than 30 days before opening and not one case of over-ripeness was reported. Of the total, 18 per cent. of the fruit was reported to be unripe, 72 per cent. ripe for eating and 10 per cent. over-ripe.

19. A few suggestions were made as to packing, for example, that the bottom boards of the boxes were too thin, that there should be wood wool between the plums, and that extra packing was needed for boxes of 12 to 14 lbs.

Pears

20. A much higher proportion of the pears reached the retailer in an unripe condition than was the case with peaches and plums, the percentages being: unripe 44 per cent., ripe for eating 51 per cent., and over-ripe 5 per cent. Seventeen shipments in all were covered and from the first six, which arrived between 25th January and 29th February, practically all the cases appear to have been opened within three weeks.

21. The next six shipments arrived between the 7th March and 11th April, and a considerable proportion of these was not opened for much longer periods, some of the cards recording periods varying from 44 to 58 days. In these cases the proportion of unripe pears was lower, but was still, on the average, more than one-third, and the proportion of over-ripe fruit was no higher than the average.

22. The last five shipments arrived between 17th April and 17th May, by which time New Zealand and Australian pears were competing in the market and most of the cases were opened within three weeks of leaving the ship.

23. There were many definite expressions of approval of the packing, but occasional complaints of bruising.

Grapes

24. The card used for grapes invited the retailer to report their condition under one of three heads: (a) sound, (b) slight waste and dropping, (c) serious waste and dropping. Returns showed 56 per cent. of the fruit sound, 34 per cent. with slight waste, and 10 per cent. with serious waste. The earlier shipments, arriving in February,

showed a very high percentage of sound fruit. The highest proportion of "waste" reports related to shipments which arrived in early April and at the end of May. The cause is believed to have been heavy rains at the period of picking.

25. The bulk of the cases of grapes was opened by the retailer within twelve days of leaving the ship. A few went into the third week, and complaints of serious wastage occurred frequently among these.

IV. THE SCOPE OF THE RETAIL SURVEY

26. The object of the retail investigation was to examine the position of South African deciduous fruit in retail shops, to discover regional preferences, and to estimate the competition of foreign deciduous fruit. For this purpose four large population centres were chosen—London, Glasgow, Birmingham and Liverpool.

27. The survey was carried out between January and April, 1932, in two sections, the first dealing mainly with peaches, plums and nectarines, and the second with pears and grapes, each shop being visited twice.

28. Owing to the limited number of investigators employed in this work, it was impossible to examine the four areas simultaneously, and this materially increases the difficulty of comparing the results in the different areas. It was considered better, therefore, to treat London separately, concentrating upon it entirely for the first three weeks of each section. The South African deciduous fruit season is so short that to allow twelve weeks for investigation it was necessary to start the survey before supplies were plentiful, and some of the differences between the results for London and those for other centres can be attributed to the time element.

29. The investigation covered 865 shops in all, 439 in London, 136 in Glasgow, 146 in Birmingham and 144 in Liverpool. Information was obtained, according to a standard questionnaire, by personal interview with the proprietor or manager of the shop, and since no complete lists of retailers were available the selection of shops to obtain a representative sample was left to the discretion of the investigators. A probable result of this method is a tendency to weight disproportionately the shops in or near the main shopping centres, but, on the other hand, there is little doubt that the most important part of the trade is covered; nor should comparison between the different areas be invalidated through this cause.

Classification of Shops

30. For purposes of analysis the shops have been classified, as in previous surveys, according to the type of organization, class of trade, and size.

(a) Organization

The grouping adopted for organization was—

- (1) Independent—a firm with less than five branches.
- (2) Multiple Stores.
- (3) Co-operative Stores.
- (4) Central Stores, the last-named including Department Stores with a fruit department, and
- (5) Market stalls.

The actual regional distribution of the shops and the percentage distribution in these groups is shown in Table 7. It will be noted that the proportion of multiple shops visited in Liverpool was considerably higher than in the other areas, while very few shops of this type were visited in Birmingham. It is clear from the special inquiries made on this point that, owing to the operations of a few larger firms, multiple shops form a much higher proportion of the total in Liverpool; it was, in fact, stated that the area was probably unique in this respect. In Birmingham the multiple shop movement has not advanced at the same rate, but the proportion of Co-operative Stores was higher than in the other centres visited.

TABLE 7.—*Regional Distribution of Shops according to type of organization*

Area.	Total Shops Visited.	Ind.	Mult.	Co-op.	Central Stores.	Market Stalls.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
London	439	81	12	2	3	2
Glasgow	136	84	13	1	2	—
Birmingham ..	146	93	1	5	1	—
Liverpool	144	57	36	2	2	3
Total	865	79	14	3	3	1

(b) *Class of Trade*

31. In determining the allocation according to class of trade, various factors were taken into account, such as the character of the district in which the shop is situated, the method of trading, i.e., cash or credit, and counter or delivery, and the nature and grade of stocks. The classification is naturally somewhat arbitrary, and there are many "border-line" shops, but on the whole there is no reason to doubt the approximate accuracy of the grouping.

32. On this basis the percentage of high, middle, and low class shops visited in each area was as shown in Table 8.

TABLE 8.—*Regional Distribution of Shops according to Class of Trade*

Area.	Total Shops Visited.	High.	Middle.	Low.
		Per Cent.	Per Cent.	Per Cent.
London	439	7	45	48
Glasgow	136	7	48	45
Birmingham	146	6	46	48
Liverpool	144	5	37	58
Total	865	7	44	49

(c) *Size of Shop*

33. Classification according to size was made with reference to the number of assistants employed. Shops with four or more assistants were grouped as large, those with two or three as medium and those with one, or none, as small. The percentage of large, medium, and small shops visited in each area is shown in Table 9.

TABLE 9.—*Regional Distribution of Shops according to Size*

Area.	Total Shops Visited.	Large.	Medium.	Small.
		Per Cent.	Per Cent.	Per Cent.
London	439	25	40	35
Glasgow	136	21	40	39
Birmingham	146	23	47	30
Liverpool	144	21	39	40
Total	865	23	41	36

34. Large shops doing a poor class trade were by no means uncommon, especially in Birmingham, but, on the average, shops in poor class districts were smaller than in areas where the trade was predominantly high or middle class. This is shown in Table 10.

TABLE 10.—*Number of Shops visited classified according to Class of Trade and Size of Shop*

Area.	Number of Shops Visited.	High and Middle.			Low.		
		Large.	Medium.	Small.	Large.	Medium.	Small.
	No.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
London.. ..	439	20	22	10	5	18	25
Glasgow	136	15	28	12	6	12	27
Birmingham ..	146	14	30	6	9	17	24
Liverpool	144	13	22	6	8	17	34

V. GENERAL CONDITIONS IN THE AREAS

London

35. While the effects of trade depression and unemployment were strongly marked, they were not so universally in evidence in London as in cities dependent upon a few big industries of the types that have suffered most severely. It was, however, noticeable that complaints of diminished trade in London came with fully as much emphasis from high-class central fruiterers as from the smaller shops in poorer districts. The season for South African fruit coincided with the period of abnormal income-tax collection, and luxury purchases were being extensively curtailed. It was found that many banquets usually held at that time of year were being cancelled, and shops which supplied West End Clubs and large catering establishments were selling much less fruit than usual.

36. In the poorer parts of London a considerable proportion of the fruit purchased is for invalids and sick people, which accounts for the frequent preference for black grapes in spite of their being usually

the more expensive. In many shops attractive-looking little trays or baskets of mixed fruits are put up in readiness for visiting days at hospitals and for the week-end trade.

37. Street Markets.—In London a material proportion of the trade in fresh fruit is carried on by street traders, the majority of whom have regular stands in the street markets, while a smaller number move about the streets with barrows. In the Metropolitan area there are about a hundred street markets, with a varying number of fruit and vegetable stalls in each. At some of these stalls the sales of fruit are much larger than in the average small fruiterer's shop, and many of the stall-keepers are highly experienced fruiterers. The trade carried on is by no means only with the poorest class, for, although the majority of the street markets are situated in poor localities, they attract large numbers of middle-class housewives, and buyers for boarding-houses.

Glasgow

38. At the time of the survey, trade conditions in Glasgow were exceptionally depressed. There was no ship-building in progress, and the many subsidiary industries dependent upon ship-building were at a standstill. All classes were affected, and the buying of luxuries such as winter peaches, plums and nectarines, was much below normal. Of 61 fruiterers who were able to compare their sales in 1932 with the corresponding sales in 1931, about half stated that there had been a falling-off, in spite of the fact that peaches had lately been cheaper and more plentiful.

39. In the centre of the city are clustered about half-a-dozen large shops, some of them purely fruiterers and others combining a fruit department with the sale of provisions or confectionery; the aggregate sales of these shops are very much larger than those of any similar group elsewhere in Glasgow. In the main they do a definitely high class trade. In some outlying areas individual shops are to be found doing a similar class of trade, though on a smaller scale. A feature of the Glasgow fruit trade is the number of very small shops in the poor districts. On the other hand, the street-barrow trade is much less in evidence in Glasgow than in London, its place being taken by these small shops, combining a trade in greengrocery and fruit with one in sweets.

Birmingham

40. Although Birmingham, in common with other large industrial centres, was affected by the prevailing trade depression, the number and variety of its industries tended to make the position somewhat less acute than in other large provincial towns. During the period covered by the survey, the local motor industry was considerably affected and some thousands of employees were either working "short time" or totally unemployed. Subsidiary trades were thereby affected and the sales of what are regarded to a certain extent as "luxury fruits" suffered accordingly. Of the 71 retailers who made any statement concerning the variation of sales between 1931 and 1932, 33, or 46 per cent., showed an increase, 17 (24 per cent.) a decrease, and 21 (30 per cent.) steady sales.

41. The sale of peaches was stated to be mainly confined to the week-end, mid-week sales being very small and in some cases negligible. The sale of plums was more evenly spread over the week, but in many instances the recent introduction of English canned plums was said to have affected the sale of the fresh variety. Owing to its proximity to one of the large centres of the fruit canning industry, Birmingham fruiterers probably feel this competition more acutely than most provincial towns.

42. With few exceptions, such as those shops catering for a high class trade, fruiterers in Birmingham also carry on the business of fishmongers, devoting one half of the shop premises to each branch of the trade. In some of the larger shops each department has its own staff, but in the smaller shops the service is usually indiscriminate.

Liverpool

43. Conditions in Liverpool also showed severe depression, both of staple industries and their subsidiary trades.

44. Trade is chiefly at the week-ends with the exception of the hospital trade—mainly in black grapes—of which there is a little at all times. Of the 56 retailers who made any statement concerning annual variation of trade, 19 per cent. showed an increase over last year, 21 per cent. a decrease, and 60 per cent. steady sales. Taken separately the figures showed a slight increase in the sales of peaches, fairly steady sales of plums and grapes, but a decided decrease in the sales of pears.

VI. RETAIL TRADE—DISTRIBUTION AND SALES

45. In all, fourteen South African fruits, of which five had an appreciable sale, were noted during the survey. Table 11 shows the number of shops stocking the most important fruits during the first and second visits in each area.

TABLE 11.—Percentage of Shops in each area stocking the principal South African Fruits

Area.	Period of Visit.	Number of Shops Visited.	Percentage of Shops Stocking				
			Peaches.	Plums.	Nectarines.	Pears.	Grapes
London ..	Jan. 11th—30th	439	Per Cent. 61	Per Cent. 67	Per Cent. 1	Per Cent. —	Per Cent. —
	Feb. 22nd—March 12th.	439	9	9	10	54	62
Glasgow ..	Feb. 1st—20th ..	136	71	75	5	—	—
	Mar. 14th—Apl. 2nd.	136	6	8	16	50	83
Birmingham	Feb. 1st—20th ..	146	43	57	1	—	—
	Mar. 14th—Apl. 2nd.	146	3	2	3	69	65
Liverpool..	Feb. 1st—20th ..	144	41	47	4	—	—
	Mar. 14th—Apl. 2nd.	144	1	1	—	41	51

46. Of the remaining fruits 11 shops, all in London, were found to be stocking apricots during the first visit, and one shop, also in London, oranges. A wider selection of the minor fruits was noted in the course of the second visit, although the numbers were small. In all 18 shops were stocking pineapples, of which 7 were in London, 4 in Glasgow, 5 in Birmingham and 2 in Liverpool; 6 London and 2 Glasgow shops had stocks of litchies, and 4 shops in London and 1 in Liverpool were stocking mangoes. Melons, apples, custard apples and passion fruit were also noted in a few shops, principally in London.

47. At the time when South African peaches and plums are on the market there are practically no supplies from other sources, but the position is different in regard to pears and grapes which are subjected to competition from a number of countries. The percentage of shops stocking pears and grapes from various sources is shown in Table 12 ; for the purpose of comparison the figures for South Africa given in the previous table have been included.

48. Competition from United States and Argentine pears, particularly the former, was keenest in London and Glasgow, and this is reflected in the lower percentage of shops stocking South African pears in these areas as compared with Birmingham, where American pears were less in evidence. Grapes were also found in greater variety in London, in which comparatively fewer shops were stocking the South African fruit, than in either Glasgow or Birmingham.

TABLE 12.—*Percentage of Shops in each area stocking Pears and Grapes*

Fruit and Country of Origin.	London.	Glasgow.	Birmingham.	Liverpool.
<i>Pears</i>	Per Cent.	Per Cent.	Per Cent.	Per Cent.
South Africa	54	50	69	41
United States	54	58	8	12
Argentina	19	6	8	18
<i>Grapes</i>				
South Africa	62	83	65	51
United Kingdom	15	1	—	—
Belgium	22	9	5	4
Spain	7	1	—	—

49. It will be noted from Table 11 above that plums appeared to be the most popular South African fruit in London, grapes in Glasgow and Liverpool and pears in Birmingham ; plums were more widely stocked than peaches in all centres, and grapes more widely than pears in all areas except Birmingham, where competition from foreign pears was least severe. The percentage of shops stocking

peaches and plums in London and Glasgow was appreciably higher than in Birmingham and Liverpool, but, on the other hand, a higher proportion of shops was stocking South African pears in Birmingham, where United States and Argentine pears were less favoured, than in any of the other areas. Grapes from South Africa were stocked in over half the shops in every area, but the percentage was highest in Glasgow where the proportion of shops was the largest recorded for any fruit. The proportion of shops stocking nectarines was small in all areas, and the low figure for London on the first visit was due mainly to the light supplies then available.

50. Probably the most striking feature of Table 11, however, is the difference revealed between Glasgow and the other areas especially London. With the exception of pears, the proportion of shops stocking the principal fruits was higher in Glasgow than in London, Birmingham or Liverpool. Part of the difference between London and Glasgow is attributable to the fact, already mentioned, that the survey took place in London early in the season when supplies were not plentiful. But the time factor does not explain the differences between Glasgow and other provincial towns, and only emphasizes the differences between London and centres other than Glasgow. This question is examined in the following paragraphs, in which the results have been analysed according to the period of the survey, and classified according to the class of trade.

Shops stocking South African Peaches, Plums, Pears and Grapes

Peaches and Plums

51. It will be seen from Tables 13 and 14 that the influence of the earliness of the season affected the results obtained for both fruits and both groups of shops during the first week's survey in London. The proportion of stockists increased as the survey progressed, and the extension was especially marked among the shops in poorer districts. In the first week of the survey a number of retailers, particularly in small shops of this type in London, stated that they were unable to stock peaches and plums until it was possible to sell at from 2*d.* to 3*d.* each for peaches and 6*d.* per lb. for plums. At

this time the usual price for plums was about 8d. per lb. and several retailers pointed out that with apples and rhubarb much cheaper plums could not be sold in poorer districts at this price.

52. In the fourth week, when the survey was commenced outside London, supplies were plentiful and this is reflected in the comparatively higher percentages for Glasgow and Birmingham. But even in Glasgow where, it will be remembered, the percentage of shops stocking these fruits over the whole survey was larger than in London, the proportion stocking in the first week was lower than in the final week in London. Liverpool clearly showed different characteristics and more closely resembled London; the proportion of shops stocking peaches and plums in this area increased throughout the survey, the peak being reached in the third week in that area.

53. For both fruits the highest proportion in Glasgow was recorded in the fifth week, the decline in the sixth and final week no doubt being largely due to the arrival of pears and grapes on the market, although at that time peaches and plums were still in good supply. It may be noted that apart from the first week in each area the results for plums in London and Glasgow differed only slightly; on the same basis of comparison there was a wider divergence for peaches.

54. Peaches and plums were stocked mainly in shops doing a high or middle class trade. Practically all the shops classed as high were stocking South African peaches, and all shops of this type were stocking plums. The proportion of middle class shops stocking both fruits was also high in all areas. Peaches were more definitely a high class trade than plums, although there were differences as between areas. Among the shops stocking peaches in Glasgow and London the distribution between the high and middle group on the one hand, and the shops classed as low on the other, was about the same, but in Birmingham and Liverpool, particularly the former, comparatively fewer shops in the poorer districts were stocking this fruit. In the shops stocking plums the distribution between the two groups was more even than in the other centres; the disproportion was greatest in Liverpool and Birmingham where, as compared with London and Glasgow, comparatively few of the poor class shops were stocking plums.

TABLE 13.—Percentage of shops stocking South African Peaches analysed according to Class of Shop and Period of Survey

Class of Trade and Area.	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.
<i>High and Middle—</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
London	61	83	88	—	—	—
Glasgow	—	—	—	81	96	85
Birmingham	—	—	—	72	59	79
Liverpool	—	—	—	20	72	100
<i>Low—</i>						
London	15	47	55	—	—	—
Glasgow	—	—	—	47	48	52
Birmingham	—	—	—	21	4	10
Liverpool	—	—	—	—	20	41
<i>Total—</i>						
London	46	69	68	—	—	—
Glasgow	—	—	—	65	76	70
Birmingham	—	—	—	43	33	53
Liverpool	—	—	—	7	38	74

TABLE 14.—Percentage of shops stocking South African Plums analysed according to Class of Shop and Period of Survey

Class of Trade and Area.	1st Week.	2nd Week.	3rd Week.	4th Week.	5th Week.	6th Week.
<i>High and Middle—</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
London	73	88	88	—	—	—
Glasgow	—	—	—	95	93	85
Birmingham	—	—	—	83	75	73
Liverpool	—	—	—	47	78	100
<i>Low—</i>						
London	23	55	69	—	—	—
Glasgow	—	—	—	53	57	57
Birmingham	—	—	—	42	25	35
Liverpool	—	—	—	22	11	41
<i>Total—</i>						
London	49	76	76	—	—	—
Glasgow	—	—	—	75	77	72
Birmingham	—	—	—	59	51	58
Liverpool	—	—	—	31	34	73

Pears and Grapes

55. The percentage of shops stocking these fruits increased in each week of the survey both in London and Glasgow. The figures, given in Tables 15 and 16, for the first week in London, show the effect of the light supplies, but the influence of the seasonal factor was rather less marked than for peaches and plums.

56. Owing to the relatively high proportion of shops in the poorer districts which were stocking pears, Birmingham was definitely in advance of the other areas, with London second and Glasgow third. In both groups of shops Glasgow showed the highest proportion of shops stocking grapes; Birmingham probably came next, though only slightly ahead of London. But both in pears and grapes the steady increase in the proportion of shops stocking the fruit in London as the survey progressed suggests that London might have appeared more favourably if it had been possible to carry out the enquiry simultaneously in all areas.

57. It has already been noted in the consideration of peaches and plums that the position in Liverpool more closely resembled that in London, and the same features were revealed in regard to pears and grapes. In the first week the proportion of shops stocking these fruits was low and the peak occurred in the last week.

58. The trade in pears and grapes was on the whole more evenly spread over the different classes of shop than the trade in peaches and plums. All the high class shops visited were stocking South African grapes, but a few in London and Glasgow were not stocking pears. The tendency to more even distribution between the two groups of shops was more pronounced for pears, which were found more frequently than other fruits in the shops classed as low, particularly in London and Birmingham. In Glasgow and Liverpool the disproportion in favour of the high and middle group was greater than in the other two areas.

59. As regards grapes there was less variation among the different areas in the relative position of the two groups of shops than for any of the fruits; in London and Glasgow the distribution was rather wider than in Birmingham and Liverpool.

TABLE 15.—Percentage of shops stocking South African Pears analysed according to Class of Shop and Period of Survey

Class of Trade and Area.	7th Week.	8th Week.	9th Week.	10th Week.	11th Week.	12th Week.
<i>High and Middle—</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
London	56	61	66	—	—	—
Glasgow	—	—	—	52	61	65
Birmingham	—	—	—	78	77	90
Liverpool	—	—	—	53	67	70
<i>Low—</i>						
London	36	47	56	—	—	—
Glasgow	—	—	—	37	33	38
Birmingham	—	—	—	58	44	59
Liverpool	—	—	—	22	14	41
<i>Total—</i>						
London	48	56	60	—	—	—
Glasgow	—	—	—	45	49	53
Birmingham	—	—	—	67	61	77
Liverpool	—	—	—	33	32	57

TABLE 16.—Percentage of shops stocking South African Grapes analysed according to Class of Shop and Period of Survey

Class of Trade and Area.	7th Week.	8th Week.	9th Week.	10th Week.	11th Week.	12th Week.
<i>High and Middle—</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
London	75	79	86	—	—	—
Glasgow	—	—	—	95	96	97
Birmingham	—	—	—	95	73	90
Liverpool	—	—	—	47	89	70
<i>Low—</i>						
London	28	45	57	—	—	—
Glasgow	—	—	—	63	67	60
Birmingham	—	—	—	58	32	41
Liverpool	—	—	—	18	31	41
<i>Total—</i>						
London	53	66	69	—	—	—
Glasgow	—	—	—	80	84	85
Birmingham	—	—	—	71	53	70
Liverpool	—	—	—	29	51	69

Sales

60. In considering sales two important points must be taken into account, viz., the seasonal difficulty, already dealt with from one aspect, and the position of Central Stores and similar shops, where sales bear no comparison with those of ordinary establishments.

61. *Central Stores.*—Of a total of 865 shops visited in the four areas 22 were large Central Stores, but as Table 17 shows, although shops of this type accounted for about 4 per cent. only of the shops stocking South African peaches, plums, pears and grapes, sales varied from 20 to nearly 29 per cent. of the total sales of each fruit.

TABLE 17.—*Comparison of Sales of South African Fruits in Central Stores with Total Sales*

Fruit.	Number of Shops Stocking (all areas).	Central Stores.		Total Sales (all areas). 000 lbs.	Sales in Central Stores. 000 lbs.	Percentage of Total Sales by Central Stores. Per cent.
		No.	Per cent. of total.			
Peaches ..	484	21	4·3	56·5	16·1	28·5
Plums ..	545	20	3·7	52·4	10·5	20·0
Pears ..	465	18	3·9	69·4	16·1	23·2
Grapes ..	555	20	3·6	44·1	12·5	28·3

62. These figures do not mean that between 20 and 30 per cent. of the South African fruit sold in the four areas is disposed of through the medium of Central Stores. These stores were undoubtedly much better represented in the sample visited than were other types of shops, and the figures should be read with this reservation. It is nevertheless evident that Central Stores account for a relatively large percentage of the total trade, and it is clear that in analysing the general trend results would be distorted by the inclusion of these large establishments in average figures. This applies particularly to average sales, and in the later stages of this report, dealing with the sales aspect, sales in Central Stores have generally been excluded, or considered separately.

63. *Seasonal Trend.*—It has already been noted that the period when the survey was undertaken had an important effect on the number of shops stocking these fruits, especially in the first week of the London survey. It will, however, be seen from Table 18 showing total sales (excluding sales in Central Stores) during each week of the survey that the seasonal factor also influenced results in the other areas.

TABLE 18.—*Comparison of Total Weekly Sales of South African Fruits in the different areas (excluding Central Stores)*

Area and Period of Survey.	Peaches.	Plums.	Pears.	Grapes.
	lbs.	lbs.	lbs.	lbs.
<i>London—</i>				
1st week	5,280	6,491	6,021	4,399
2nd week	7,632	9,062	7,607	3,913
3rd week	11,560	10,492	10,434	5,830
<i>Glasgow—</i>				
1st week	2,672	2,141	3,285	2,007
2nd week	3,984	3,315	3,165	3,876
3rd week	2,464	1,413	5,680	3,195
<i>Birmingham—</i>				
1st week	632	1,049	2,495	1,216
2nd week	1,880	1,540	5,159	1,823
3rd week	2,264	4,050	5,551	3,185
<i>Liverpool—</i>				
1st week	80	369	658	350
2nd week	324	491	732	565
3rd week	1,604	1,560	2,464	1,270

64. It should be borne in mind in considering the figures in this table that the first three weeks of each part of the survey took place in London and that these were followed in each case by simultaneous visits extending over three weeks in the other towns. The number of shops visited in each week in London and in the provinces was approximately the same, between 140 and 150 in the former, and between 40 and 50 in the latter. Moreover, the proportion of the different classes visited was fairly uniform throughout.

65. In London, Birmingham and Liverpool there was a general tendency for sales to increase during the course of the survey. The upward movement was most marked in Liverpool where, it may be noted, sales were much lower than in Glasgow or Birmingham, with which comparison may fairly be made. In Glasgow, however, the trend was different, and, except for pears, the peak of sales was reached in the second week of each visit, the final week showing a substantial decline, especially for peaches and plums. This decline may have been due to the ample supplies of foreign pears on the market, and to the early arrivals of this fruit from South Africa.

66. *Average Sales.*—In Table 19 are shown average sales per shop of South African peaches, plums, pears and grapes, the averages being based on the number of shops from which records were obtained. The highest averages for peaches and plums were recorded in London, but the Glasgow averages for pears and grapes were appreciably greater than in the other areas. The principal reason for the high average for pears in Glasgow was the exceptional sales in four large shops, two independent and two multiple, which accounted for over 60 per cent. of the total sales in shops other than Central Stores. The same factor had some influence on the averages for peaches and grapes, though for these fruits it was less important.

TABLE 19.—*Average weekly sales of the principal South African Fruits (excluding Central Stores)*

Fruit.			London.	Glasgow.	Birmingham.	Liverpool.
			lbs.	lbs.	lbs.	lbs.
Peaches	..	..	101	98	75	36
Plums	..	..	101	72	77	36
Pears	..	..	125	222	102	68
Grapes	..	..	60	84	64	32

67. The figures shown in Table 19 are subject to qualifications somewhat similar to those already indicated in preceding paragraphs dealing with the proportion of stockists, but on the whole it appears undesirable and possibly misleading to set out the results in the same form. The principal defect of this method as applied to sales

is that, in a comparatively small sample, the results are materially affected by the type of shop, particularly by its size. A preponderance of one type in any week, a not unlikely contingency where only one investigator is at work, would obscure the general trend. The analysis was, however, made and yielded some interesting points, especially in regard to the comparative position in London and Glasgow, which may now be mentioned.

68. Considered broadly the seasonal factor had a less noticeable effect in London on average sales per shop than on the number of shops stocking the fruits, and while the upward trend as the survey progressed is clearly evident, it appears that the increased supplies, at the correspondingly lowered prices, were disposed of more by the multiplication of selling points than by larger sales per shop. In Birmingham, where the proportion of stockists to shops visited showed little change during the course of the survey, the average sales per shop increased rapidly. In Liverpool, shops stocking and average sales increased rapidly during the three weeks of the survey, whilst in Glasgow, the sales figures (which show rather pronounced fluctuations) follow much the same trend as those of shops stocking, the peak occurring in the second week.

69. As regards the individual fruits it may be noted that average sales of peaches in London and Liverpool tended to expand during the course of the survey, and in the third week, by which time the season was in full swing, the average was higher than in any week in any area. Direct comparison between London and Glasgow is difficult, but it seems not unlikely that simultaneous surveys in the two areas would have resulted in a wider difference in London's favour than is suggested by the averages of 101 lbs. and 98 lbs. given in Table 19.

70. Average sales of plums were clearly higher in London than in Glasgow, but in no single week did they attain the high average reached in the third week in Birmingham. The exceptional figure recorded in that week was primarily due to the high average for the shops classed as low, influenced by the abnormally high sales in a large independent retail shop. The result may not, therefore, be truly representative, but it remains true that sales in Birmingham in the shops in the poorer districts appeared generally to be on a higher level than in the other areas. Birmingham is, of course,

situated near to one of the chief plum growing areas in England, and all classes there are probably less accustomed to look upon plums as a luxury than are the inhabitants of towns further north.

71. It seems improbable that the seasonal factor was of any importance in determining the relative positions of London and Glasgow in average sales of pears. The average in Glasgow was clearly higher, and was in fact, considerably greater than the average for any fruit in any area. But, as already noted, this is partly explained by the exceptional sales in a few large shops.

72. The general movement in London as compared with Glasgow suggests that if there had been no difference in time between the enquiries in each area, average sales of South African grapes in Glasgow would have been little, if at all, higher than in London, although competition from foreign grapes was much more keen in London than in Glasgow. Similar considerations apply to a comparison between London and Birmingham, and the slightly larger average shop sales in the latter town, due to rather abnormal figures in the third week, may not accurately reflect the facts.

73. Among the high and middle class group of shops, average weekly sales, as would be expected, were generally higher than in the lower group. In Birmingham, however, there was much less difference between the average sales in the two groups; in the first week, for each fruit, and in other weeks occasionally, average sales in the poor class shops exceeded those in the better class establishments. The general level for all fruits in the poorer class shops in Birmingham was greater than in other areas; and it may be noted that in this area there was a higher proportion of large poor class shops, though the differences between the areas in this respect was not striking. There was not much to choose among the different fruits, but on the whole there appeared to be a smaller margin between average sales of plums and grapes in the two groups than between peaches and pears.

VII. PREFERENCES, VOLUME OF SALES AND PRICES

74. The information collected during the course of the survey on the most popular varieties and counts, volume of sales, and prices of each fruit is dealt with in the following section.

75. The question of sales has so far been treated mainly from the point of view of the shop rather than the area, but it is possible by examining aggregate sales figures to obtain some indication of the relative importance of the different areas as markets for South African fruits. In making these comparisons, however, it should be pointed out that the aggregate sales figures tend to minimise the importance of London as an outlet for South African fruit. For this there are two reasons. In the first place there is the influence of the seasonal factor to which reference has been made earlier in this report. Secondly, the number of shops visited in London was smaller in relation to population, and probably to the total number of shops, than in the three provincial areas.

76. The population of the areas covered by the survey in Birmingham, Glasgow and Liverpool is roughly the same, and in these areas the number of shops visited was also approximately equal although on this basis Glasgow, where somewhat fewer shops were visited, may be under-represented. The population of the County of London, however, is about four and a half times as great as that of each of the other areas visited but, in the limited time available, it was only possible to visit about three times as many shops as in Birmingham or Liverpool. On the assumption that the number of shops is roughly proportionate to population, the importance of London as an outlet for South African fruit is thus undervalued to the extent of about one-third by the aggregate sales figures shown in the following paragraphs. On the other hand, these considerations do not apply to the other areas visited, and comparisons between them can safely be made.

Peaches and Nectarines

Preferences

77. *Peaches*.—The most popular varieties of peaches in order of preference were *Duke of York*, *Early Alexander*, *Peregrine*, *Inkoos* and *Elberta*. The preference for *Inkoos* was mainly in London and Birmingham, Glasgow and Liverpool showing very little interest.

78. The counts most favoured by retailers and reflected in stocks in all areas were 21–28 (peaches 2–2½ in. in diameter). The preference for a white flesh peach was definite, but this may have been partly

a reflection of the available supply. The "selected" and not the "choice" grade was stocked nearly everywhere, but where the "choice" grade was found it seemed to command equally high prices.

79. *Nectarines*.—No particular variety of nectarine claimed precedence in any area, but a 25 or 28 count—a fruit of diameter 2-2½ in.—was preferred. The few sales recorded were reported to show neither an increase nor a decrease from the previous year's figures. The main reason given for not stocking this fruit was the lack of demand, but some retailers stated that the difficulty of obtaining supplies and the high price prevented them from stocking it.

Distribution of Sales

80. The distribution of sales of peaches according to area is shown in Table 20. The outstanding feature of the table is the low level of sales in Liverpool and Birmingham, especially the former. Recorded sales of nectarines were small, amounting to about 750 lbs. for the four areas. About 500 lbs. of this total were noted in Glasgow, and the remainder in Liverpool, mainly concentrated in large stores.

TABLE 20.—*Distribution of Sales of Peaches according to Area*

Area.	Number of Shops visited.	Number of Shops recording Sales.	Total Sales recorded in lbs.
London	439	255	35,800
Glasgow	136	96	12,016
Birmingham ..	146	66	5,280
Liverpool	144	59	3,400

81. It will be noted from Table 21 in which aggregate sales of South African peaches in all the areas have been classified according to the type of organisation of the shop, that sales among the independent retailers were the most important, accounting for about half

the total, while sales in Central Stores came next, but it should again be emphasized that Central Stores were more fully represented in the sample taken than were any other class of shop. Sales in branches of Co-operatives were small, and were less important than those at market stalls.

TABLE 21.—*Distribution of Sales of Peaches according to Organization*

Type of Shop.	Total Shops recording Sales—all Areas.	Total Sales recorded.	Proportion of Total Sales in each Area.			
			London.	Glasgow.	Birmingham.	Liverpool.
		lbs.	Per cent.	Per cent.	Per cent.	Per cent.
Independent ..	338	28,892	48	52	85	28
Multiple	98	10,468	19	24	1	19
Co-operative ..	12	384	(a)	(a)	4	3
Central Stores ..	20	16,096	32	24	10	41
Market Stalls ..	8	656	1	—	—	9

(a) Under .5 per cent.

82. As between the areas there was considerable variation in the relative importance of the different types of organisation. Sales in independent shops were well ahead of the other types of shop in London, Glasgow, and Birmingham, especially in the last-named area, where they amounted to over four-fifths of the total. But in Birmingham, on the other hand, only a very small proportion of sales in multiple shops was recorded; sales in these shops in London and Liverpool represented about one-fifth of the aggregate in the area, and in Glasgow nearly one-quarter.

83. The majority of shops stocking peaches sold less than 50 lbs. per week. Shops selling 500 lbs. and over accounted for 22 per cent. of the total sales. The grouping of sales is shown in Table 22.

84. In London the maximum volume of sales falls almost equally into the two highest classes (500 and upwards, and 400-499); in Glasgow, and in Liverpool to a lesser degree, the heaviest sales fall into the top class, while in Birmingham the group selling 300-399 lbs. per week shows largest sales.

85. The sales of nectarines were all below 50 lbs. per week except in two shops, one Central Store and one multiple—both in Glasgow, selling 200 and 120 lbs. respectively.

TABLE 22.—*Percentage of Shops selling various weekly quantities of Peaches*

Graduated Sales.	London.	Glasgow.	Birming- ham.	Liverpool.	All Areas.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
500 lbs. and over ..	4	6	2	2	4
400 lbs. and under 500	5	3	2	2	4
300 lbs. and under 400	2	1	5	—	2
200 lbs. and under 300	8	7	3	3	7
100 lbs. and under 200	9	1	8	3	7
50 lbs. and under 100	18	10	20	7	15
25 lbs. and under 50	22	22	23	12	21
Less than 25 lbs. ..	32	50	37	71	40
Number of Shops Re- cording Sales.	255	96	66	59	476

86. Nearly 90 per cent. of the total sales of peaches were recorded in shops classed as high and middle, the proportion for each being practically the same. In Glasgow and Liverpool the trade was more definitely high class than in either London or Birmingham.

87. Peaches are of a specially perishable nature and an assured turnover is required before they can be stocked with safety. Large shops have, therefore, a considerable advantage and over 70 per cent. of the trade was found in this type of shop.

88. Figures illustrating distribution of sales according to class of trade and size of shop are given in Table 23.

TABLE 23.—*Distribution of Sales of Peaches according to Class of Trade and Size of Shop*

Class of Trade and Size of Shop.	Total Shops recording Sales—all Areas.	Total Sales recorded.	Proportion of Total Sales in each Area.			
			London.	Glasgow.	Birmingham.	Liverpool.
		lbs.	Per cent.	Per cent.	Per cent.	Per cent.
<i>Class of Trade—</i>						
High	55	24,848	42	55	22	56
Middle	289	24,676	43	39	62	37
Low	132	6,972	15	6	16	7
<i>Size of Shop—</i>						
Large	153	40,384	71	81	71	51
Medium.. ..	220	12,644	22	16	26	44
Small	103	3,468	7	3	3	5

Prices

89. *Peaches*.—Although price varied with size, price ranges for the various counts overlapped considerably, as can be seen from Table 24.

TABLE 24.—*Retail Prices of Peaches (per fruit) according to Count*

Count.	No. of Prices recorded.	Extreme Range.	Significant Range.	Most usual Prices.	Average Price.
15	6	d. s. d. 4½ to 1 0	d. s. d. 6 to 1 0	d. —	d. 8·1
18	41	2½ to 1 0	4 to 8	4 & 6	5·9
21-24	260	2 to 8	2½ to 6	3 & 4	3·7
25-28	416	1½ to 6	2 to 4	2½ & 3	2·7

90. The general price range in the areas shows that nowhere outside London was any size of peach retailed at a greater price than 8*d.*, but the higher range in London was partly the result of short supplies, due to the earliness of the season. On the other hand, only in London and Birmingham were peaches sold at as low a price as 1½*d.* each. The prices in the following table cover all sizes of peach.

TABLE 25.—*Retail prices of Peaches (per fruit) according to Area*

Area.	No. of Prices recorded.	Extreme Range.			Significant Range.		Most usual Prices.	Average Price.	
		<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	
London ..	429	1½	to	1 3	2	to	6	3 & 4	3·5
Glasgow..	134	2	to	8	2	to	4	3	3·1
Birmingham.	82	1½	to	8	2	to	4	2 & 3	3·0
Liverpool	80	2	to	6	2½	to	4	2½	3·2
All Areas	725	1½	to	1 3	2	to	6	2½ & 3	3·3

91. The largest counts, 12 and 13, were only stocked in two London Central Stores, one selling at 1*s.* 3*d.* and the other at 7½*d.* each. The records for shops classified as low showed only two samples of any count larger than 21, and the majority of sales and the most even range of prices was in the group 25–28.

TABLE 26.—*Average Price of Peaches (per fruit) of various Counts*

Area.	Count.				
	12 and 13	15	18	21 to 24	25 to 28
London	<i>d.</i> 11·3	<i>s.</i> <i>d.</i> 1 0	<i>d.</i> 6·6	<i>d.</i> 3·8	<i>d.</i> 2·7
Glasgow	—	6·1	4·8	3·4	2·7
Birmingham	—	—	5·5	3·4	2·5
Liverpool	—	—	5·5	3·4	2·5
All Areas	11·3 (a)	8·1 (b)	5·9	3·7	2·7

(a) Two records only. (b) Six records only.

92. Prices of peaches showed a wide range irrespective of class of trade or size of shop, but although the highest prices were all concentrated in high class shops and Central Stores, those at the other end of the range were by no means confined to low class or small shops. The full range of prices from $1\frac{1}{2}d.$ to $1s. 3d.$ each was recorded for high class shops and Central Stores; for middle class shops prices varied from $1\frac{1}{2}d.$ to $8d.$ mainly grouped between $1\frac{1}{2}d.$ and $4d.$; but in low class shops only one instance was found of a price higher than $4d.$ The significant range in this class was from $2d.$ to $3d.$ each.

93. The significant range for large, medium and small shops was approximately the same, but in no case was a price below $2d.$ recorded in a small shop.

94. *Nectarines*.—Very few prices were recorded for nectarines, but so far as information goes, the range was the same in all areas.

TABLE 27.—Average Price of Nectarines (per fruit) of various Counts

Count.	No. of Prices recorded.	Extreme Range.	Significant Range.	Most usual Prices.	Average Price.
25	9	$d.$ $d.$ 3 to 6	$d.$ $d.$ 3 to 4	$d.$ 4	$d.$ 4.2
28	14	2 to 4	3 to 4	3	3.1
32	14	$1\frac{1}{2}$ to 3	2 to 3	2	2.4
Total ..	37	$1\frac{1}{2}$ to 6	2 to 4	3	3.1

Plums

Preferences

95. Varieties of plums were preferred in the following order: *Santa Rosa*, *Kelsey*, *Methley*, *Gaviota*, *Wickson* and *Apple*. The preference for *Methley* was almost entirely confined to London and the stocks reflected this preference. The stocks of *Kelsey* in all areas

were negligible, although the preference for that variety was high. This appeared to be because *Kelsey* is a dessert plum which arrives in greatest quantities towards the end of the season.

96. The packing of "choice" plums in bulk-packed boxes of from 10-20 lbs. was reported to increase their sales (by the pound) for cooking. The favourite sizes of boxes were 10, 12 and 15 lbs. With dessert tray plums counts 41-45 (plums, diameter $1\frac{1}{2}$ -2 in.) were favoured by all areas except Liverpool which preferred those ranging from 50-60 (size $1\frac{5}{8}$ - $1\frac{7}{8}$).

97. A red plum with red flesh was the favourite, but many people liked a large yellow plum for dessert.

Distribution of Sales

98. Sales of plums in Liverpool, like peaches, were on a comparatively small scale, but there was very little difference between sales in Glasgow and Birmingham. The distribution according to area is shown in Table 28.

TABLE 28.—*Distribution of Sales of Plums according to Area*

Area.	Number of Shops visited.	Number of Shops recording Sales.	Total Sales recorded (In lbs.)
London	439	270	33,740
Glasgow	136	99	7,650
Birmingham	146	88	7,412
Liverpool	144	70	3,640

99. Of the total sales of South African plums recorded in the four areas, independent shops accounted for about 60 per cent., Central Stores for 20 per cent. and multiple shops for 17 per cent. The relative importance of the different types of shops varied between areas, but only in Liverpool were the independent shops responsible for a comparatively small proportion of the total sales in the area. In London and Birmingham multiple shops seemed to be less important than in Glasgow and Liverpool, and the largest share of the Co-operative Stores was recorded in Birmingham.

100. Aggregate sales classified according to type of shop are set out in Table 29.

TABLE 29.—*Distribution of Sales of Plums according to Organisation*

Type of Shop.	Total Shops recording Sales—all Areas.	Total Sales recorded.	Proportion of Total Sales in each Area.			
			London.	Glasgow.	Birmingham.	Liverpool.
		lbs.	Per cent.	Per cent.	Per cent.	Per cent.
Independent	384	30,997	58	64	78	29
Multiple ..	96	8,802	17	26	1	25
Co-operative	17	1,294	1	(a)	11	4
Central Stores	20	10,453	23	10	10	33
Market Stalls	10	896	1	—	—	9

(a) Negligible proportion.

101. Three-quarters of the shops stocking plums sold less than 100 lbs. per week, and 60 per cent. less than 50. In Liverpool 80 per cent. of the stockists, in Birmingham 67 per cent., in Glasgow 65 per cent., and in London 52 per cent. sold less than 50 lbs. Further, in Liverpool only 2 per cent. of the stockists sold 200 lbs. or over. The distribution of sales is shown in Table 30.

TABLE 30.—*Percentage of Shops selling various weekly quantities of Plums*

Graduated Sales.	London.	Glasgow.	Birmingham.	Liverpool.	All Areas.
500 lbs. and over ..	4	1	5	1	3
400 lbs. and under 500	2	2	—	1	2
300 lbs. and under 400	3	1	1	—	2
200 lbs. and under 300	8	7	5	—	6
100 lbs. and under 200	14	6	14	6	12
50 lbs. and under 100	17	18	8	10	15
25 lbs. and under 50	27	33	35	32	30
Less than 25 lbs. ..	25	32	32	50	30
Number of shops recording sales.	270	99	88	70	527

102. The maximum volume of sales was in the highest group, but the groups selling 200-299, and 100-199 were much higher than any of the remainder. In London and Birmingham, the group, 500 lbs. and over, held the maximum, but in Glasgow the volume in that group was small and the largest volume was in the group 200-299 lbs. In Liverpool the volume of sales was more or less evenly distributed.

103. Plums are a fruit popular with all classes, and sales in all areas were more evenly distributed among the different classes of shop than was the case with peaches. Tray plums were definitely a high-class trade, but the lower priced bulk-packed plums had an extensive sale in the middle class shops, and a substantial one in the poorer districts. It must be remembered, in considering the figures for the different areas in Table 31, that, especially in London, the survey covered the beginning of the plum season when prices were higher than they became as the survey progressed. All the regular stockists had not, therefore, started to sell plums, and this would affect the figures for low class shops more than for the other two classes.

TABLE 31.—*Distribution of Sales of Plums according to Class of Trade and Size of Shop*

Class of Trade and Size of Shop.	Total Shops recording Sales—all Areas.	Total Sales recorded.	Proportion of Total Sales in each Area.			
			London.	Glasgow.	Birmingham.	Liverpool.
		lbs.	Per cent.	Per cent.	Per cent.	Per cent.
<i>Class of Trade—</i>						
High	54	16,947	32	37	26	43
Middle	300	25,910	51	49	46	41
Low	173	9,585	17	14	28	16
<i>Size of Shop—</i>						
Large	169	35,346	70	64	70	53
Medium	238	12,943	22	28	25	42
Small	120	4,153	8	8	5	5

Prices

104. Prices for bulk-packed plums varied from 4*d.* to 1*s.* 1*d.* per lb., but seven-eighths of the prices recorded were between 6*d.* and 8*d.*, these being the most usual prices. Bulk-packed plums were also sold individually at from 1*d.* to 3*d.* each. Tray plums of counts 24-45 were generally sold at 8*d.* per lb. or 1½*d.*-3*d.* each, and counts 50-68 mostly at 6*d.* or 8*d.* a lb., or 1*d.* and 1½*d.* each.

105. The price per pound was on the average higher for the larger plums, whether they were sold individually or by weight. Generally, plums which were sold individually fetched a considerably higher price, weight for weight, than those sold by the pound, the better fruits presumably being selected for this method of sale. The records for all the areas have been summarised in Table 32.

TABLE 32.—*Retail Prices of Plums according to Count*

Description.	No. of Prices recorded.	Extreme Range.		Significant Range.		Most usual Prices.		Average Prices.	
		Per lb.	Each.	Per lb.	Each.	Per lb.	Each.	Per lb.	Each.
Bulk Packed ..	554	d. s. d.	d. d.	d. d.	d. d.	d. d.	d. d.	d. d.	d. d.
50-68	92	4 to 1 1	1 to 3	6 to 8	1 to 2	6 & 8	1 & 2	7.0	1.6
34-45	86	5 to 1 0	1 to 4	6 to 8	1 to 2	8	1 & 1½	8.0	1.5
24-32	6	4½ to 1 0	1 to 4	6 to 10	1½ to 3	8	2	8.5	2.2
		8 <i>d.</i>	2 to 4	—	—	8	—	8.0	2.9

106. During the survey in London, prices were falling. In the other areas no significant movement was observed, except in Glasgow where the level was rising. As can be seen from Table 33, average prices per pound were higher in Glasgow than elsewhere, 8*d.* being the most usual price for bulk-packed. Plums were sold individually, however, at lower prices in this area than in others, and this method of sale was rather more usual. In Birmingham prices were low; the most usual price was 6*d.* per lb. and this was about the average for bulk-packed plums.

TABLE 33.—Retail Prices of Plums according to Area

Area.	No. of Prices recorded.	Extreme Range.		Significant Range.		Most usual Prices.		Average Prices.	
		Per lb.	Each.	Per lb.	Each.	Per lb.	Each.	Per lb.	Each.
London ..	357	d. s. d.	d. d.	d. s. d.	d. d.	d.	d.	d.	d.
Glasgow ..	180	4 to 1 1	1 to 4	6 to 8	1 to 4	6 & 8	1 & 2	7.0	2.1
Birmingham ..	116	4 to 1 0	1 to 3	6 to 1 0	1 to 2	8	1½	8.2	1.6
Liverpool ..	85	4 to 10	1 to 3	6 to 8	1 to 2½	6	2½	6.2	2.1
		4½ to 10	1 to 4	6 to 8	1 to 3	6 & 8	2 & 3	7.1	2.2
All Areas ..	738	4 to 1 1	1 to 4	5 to 10	1 to 3	6 & 8	1½ & 2	7.1	1.9

107. On the whole the general level of prices tended to be lower in the larger shops than in the smaller. The class of trade of a shop did not greatly influence the price, but the average was slightly higher in those doing a better class of business.

Pears

Preferences

108. The fact which emerged most widely and emphatically both in London and the provincial areas was the difficulty experienced by retailers with the *Bon Chrétien* variety. While it was agreed that this pear had a nice flavour and an attractive appearance, complaints were widespread of its rapid deterioration after ripening. It is one of the earliest arrivals among pears from South Africa, but fruiterers often stated that in order to avoid it they frequently continued with the American *Winter Nelis* until South African *Beurre Hardy* or other similar variety could be obtained.

109. The most popular varieties in order of general preference were *Doyenne du Comice*, *Beurre Hardy*, *Winter Nelis*, *Bon Chrétien*, *Louise Bonne* and *Beurre Bosc*. London retailers favoured the *Keiffer*, which was not popular in the provinces, but Glasgow showed a marked preference for *Beurre Hardy*, and Birmingham, in a slight degree, for *Winter Nelis*.

110. At the time of the survey *Bon Chrétien* were arriving in greater quantities than any other variety. *Doyenne du Comice* were still scarce and *Beurre Hardy* were just beginning to be plentiful, so that the actual stocks of these did not reflect the popularity of the variety.

111. It is interesting to note that the stocks and sales of *Beurre Bosc* were negligible in London, but were fairly heavy in the other three towns. The considerable demand observed for *Winter Nelis* was probably to a great extent a reflection of the overlap of the American season, of which the *Winter Nelis* is the main crop. The South African supply of this variety is not shipped until nearly the end of the deciduous season, which accounts for the fact that during the survey only one sample was discovered.

112. Both the statements of the retailer and the stocks in all areas indicated a preference for a pear varying in diameter from $2\frac{1}{4}$ - $2\frac{3}{4}$ in. More than 50 per cent. of the stocks of pears in trays were within the range 32-21 count (diameter $2\frac{1}{4}$ - $2\frac{3}{4}$ in.) while 75 per cent. of the box pears were in counts from 203-120 (diameter $2\frac{1}{4}$ - $2\frac{3}{8}$ in.) the favourite count in trays being 25 ($2\frac{1}{2}$ in.) and in boxes 160 ($2\frac{3}{4}$ in.). A fairly firm greenish yellow pear was generally preferred to a fully ripe, soft, yellow one in all areas but Glasgow.

Distribution of Sales

113. Unlike peaches, nectarines and plums, South African pears are subject to competition from supplies from other sources, chiefly foreign. At the time of the survey a few of the shops visited in London were stocking Canadian and Australian pears, but the sales of these formed only a small proportion of the supplies other than South African.

114. The effect of this competition is shown in Table 34, showing aggregate sales of South African and foreign pears and average weekly sales, including Central Stores. It should be noted that to indicate more clearly the relative importance of pears from South Africa and pears from foreign countries the averages are based on the total of the shops in each area for which sales records were obtained.

115. The table also illustrates the marked difference between the position in London and that in the other areas, where, especially in Birmingham, foreign competition was much less effective. It shows also that the low sales of the South African fruit in Liverpool were not due to the pressure of foreign supplies. South African sales recorded in this area were nearly four times as great as foreign, although considerable quantities of United States and Argentine pears enter the port. The foreign pears were United States—mainly *Winter Nelis*—and Argentine *Williams* in the proportion of 73 to 27.

TABLE 34.—*Sales of South African and Foreign Pears*

Area.	Number of Sales Records.	Aggregate Sales.			Average Weekly Sales (including Central Stores).		
		South African.	Foreign.	Total.	South African.	Foreign.	Total.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
London ..	370	27,052	35,165	62,567 ^(a)	73	95	169 ^(a)
Glasgow ..	134	20,430	9,245	29,675	152	69	221
Birmingham	117	13,565	1,275	14,840	116	11	127
Liverpool ..	98	8,338	2,293	10,631	85	23	108

(a) Including small quantities of Canadian and Australian pears.

116. The variety of practice in the shops in the different areas can be seen in Table 35. In London over half the total sales were recorded in shops stocking both South African and foreign pears, while only 17 per cent. of the total occurred in shops where sales were confined to South African pears alone. Birmingham, on the other hand, afforded an example of the opposite tendency; in this area nearly nine-tenths of the total sales were recorded in shops where only South African pears were on sale.

TABLE 35.—*Distribution of Sales of Pears between South African and Foreign*

Area.	Total Sales.	Percentage of Total Sales in Shops Stocking		
		South African only.	Foreign only.	South African and Foreign together.
	lbs.	Per cent.	Per cent.	Per cent.
London ..	62,567 ^(a)	17	30	52
Glasgow ..	29,675	59	27	14
Birmingham ..	14,840	87	6	7
Liverpool ..	10,631	74	17	9

(a) Including small quantities of Canadian and Australian pears.

117. The majority of shops stocking pears were selling under 100 lbs. per week and nearly one-third of them were selling less than 50 lbs. But the greatest volume of sales was in the group selling over 500 lbs. per week.

TABLE 36.—*Percentage of Shops selling various weekly quantities of Pears (from all sources)*

Graduated Sales.	London.	Glasgow.	Birmingham.	Liverpool.	All Areas.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
500 lbs. and over ..	6	7	7	5	6
400 lbs. and under 500..	4	3	1	—	3
300 lbs. and under 400..	5	1	2	2	3
200 lbs. and under 300..	14	8	3	4	10
100 lbs. and under 200..	21	13	15	9	17
50 lbs. and under 100 ..	27	37	37	19	30
Less than 50 lbs. ..	23	31	35	61	31
Number of Shops recording Sales.. ..	370	134	117	98	719

118. Independent shops accounted for over 60 per cent. of the sales of pears in the four areas, multiple shops being next with nearly 20 per cent. The proportion of the total sales of foreign pears in independent and multiple shops was appreciably higher than the corresponding figures for South African pears, but on the other hand, a far larger percentage of the total sales of the latter occurred in Central Stores.

119. As between the areas the proportions varied considerably among the different types of shop. Over 90 per cent. of the pear sales in Birmingham were recorded in independent shops; in Liverpool the distribution was more even, the largest share being taken by the Central Stores.

TABLE 37.—*Distribution of Sales of Pears according to Organisation*

Type of Shop.	Total Sales recorded.		Proportion of Total Sales of all Pears in each Area.			
	South African.	Foreign.	London.	Glasgow.	Birmingham.	Liverpool.
	lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.
Independent ..	40,582	34,303	68	51	92	30
Multiple ..	10,199	10,605	20	21	1	18
Co-operative ..	1,200	360	1	(a)	4	2
Central Stores ..	16,134	2,290	9	28	3	42
Market Stalls ..	1,270	420	2	—	—	8

(a) Negligible proportion.

120. Pears are popular with all classes, but at the same time they are on the border line of the luxury fruit trade. About half the sales of all pears occurred in shops doing a middle class trade, the remainder being nearly equally divided between high and poor class shops. In Glasgow and Liverpool pears appeared to be more definitely a high class trade than in London and Birmingham where sales were heavier in the middle and lower class of shop. The main demand for South African pears came from high and middle class

shops ; about 80 per cent. of the sales in high class shops were South African pears. This is brought out in Table 38, in which sales are also classified according to the size of shop.

TABLE 38.—*Distribution of Sales of Pears according to Class of Trade and Size of Shop*

Class of Trade and Size of Shop.	Total Sales recorded.		Proportion of Total Sales of all Pears in each Area.			
	South African.	Foreign.	London.	Glasgow.	Birmingham.	Liverpool.
<i>Class of Trade—</i>	lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.
High	26,574	6,150	18	48	15	48
Middle	28,994	27,612	55	35	53	37
Low	13,817	14,216	27	17	32	15
<i>Size of Shops—</i>						
Large	44,266	22,510	50	72	55	54
Medium	18,031	17,443	35	18	36	37
Small	7,088	8,025	15	10	9	9

Prices

121. Pears are sold both individually and by the pound and for this reason the calculation of a general average price is practically impossible. The price per lb. varied from 4*d.* to 1*s.* 6*d.*, and in 80 per cent. of the cases was between 5*d.* and 10*d.*, 6*d.* being the most usual price.

122. Prices for single pears ranged from 1*d.* to 10*d.*, but by far the greatest number sold at from 2*d.* to 6*d.* each. The most usual price was 2*d.* Count appeared to make little difference in price per lb. but, generally speaking, larger pears were higher in price when sold individually than when sold by the pound. Grade, as in the case of peaches, had little or no effect on price.

123. In Glasgow prices per lb. were considerably higher than in the other areas and only 18 instances were found of pears sold singly. In Liverpool, on the other hand, 80 per cent. of the pears were sold in this way.

124. The price per lb. varied very little with class or size of shop, but single pears were more expensive the higher the class of shop. The significant range in high class trade was 2*d.* to 6*d.*, in middle 1½*d.* to 4*d.*, and in low from 1½*d.* to 3*d.*

125. As already noted the pears which compete with the South African varieties on the British market come from the United States and Argentina. Significant price ranges were very similar although South African pears, sold by the pound, fetched a higher average price than either of their competitors, as can be seen from Table 39.

TABLE 39.—*Comparative Prices of South African and Foreign Pears*

Country of Origin.	No. of Prices recorded.	Extreme Range.		Significant Range.		Most usual Prices.		Average Prices.	
		Per lb.	Each.	Per lb.	Each.	Per lb.	Each.	Per lb.	Each.
South Africa ..	543	d. s. d.	d. d.	d. d.	d. d.	d.	d.	d.	d.
United States ..	476	4 to 1 6	1 to 10	5 to 10	1½ to 4	6 & 8	2 & 2½	7.6	2.8
Argentina ..	149	4 to 10	1 to 6	6 to 10	1½ to 4	6 & 8	2	7.0	2.5
		5 to 10	1 to 6	6 to 8	1½ to 3	6	2	6.7	2.5

Grapes

Preferences

126. The fact that South African grapes followed immediately after the cheap Almeria grapes from Spain was stated to be a difficulty experienced by fruiterers in poor and middle class districts. People who had become used during the winter months to buying green grapes at 6*d.* and 8*d.* a lb. failed to understand their sudden rise in price to 1*s.* 2*d.* or 1*s.* 4*d.* and this militated against the sale of the South African varieties. Many customers who were quite ready to pay the higher prices for black grapes refused to do so for green. Last year the Almeria grape season closed unusually early, and the jump in price was bridged to a certain extent by grapes from California, retailed at 10*d.* or 1*s.*

127. The most popular South African varieties, arranged in order, were *Waltham Cross*, *Hanepoot White*, *Gros Colmar*, *Hanepoot Red* and *Rosaki*. A considerable liking was expressed for *Almeria*, although the stocks actually carried were small in all areas. In London the *Hermitage* variety was common, but it was neglected elsewhere.

128. There appeared to be very little difference in stocks, or sales between the two main grades of grape. In many cases "choice" grapes commanded a considerably higher price than "selected" of the same variety, and stocks were distributed between "selected" and "choice" in the ratio of 53 to 47.

Distribution of Sales

129. Grapes from South Africa, like pears, are on sale at a time when supplies from other sources, chiefly foreign, are available. When the survey took place the South African varieties were the most important on the market, but a number of shops, mainly in London, were stocking Belgian *Gros Colmar* hothouse grapes, and a few in London and Glasgow had Almerias, effective competition from which declined as the survey progressed. English hothouse grapes were found only in London, and a few shops in Liverpool were stocking grapes from Argentina. One shop in Birmingham was stocking Australian grapes.

130. The competitive position is shown in Table 40, which gives aggregate sales of South African and foreign grapes, and average weekly sales. As in the similar table for pears, to indicate more clearly the relative importance of South African and foreign grapes the averages are based on the total of shops in each area for which sales records were obtained, and sales in Central Stores are included in the calculations.

131. Over 80 per cent. of the grape sales in the four areas were South African, and about 3 per cent. "Other Empire," almost entirely English. Sales of foreign grapes were proportionately largest in London; in the other areas they accounted for only a small percentage of the total sales.

TABLE 40.—*Sales of South African and Foreign Grapes*

Area.	Number of Sales Records.	Total Sales.			Average Weekly Sales (including Central Stores).		
		South African.	Foreign.	Total.	South African.	Foreign.	Total.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
London ..	291	16,072	5,740	23,459 ^(a)	55	20	80
Glasgow ..	113	17,578	651	18,229	155	6	161
Birmingham	92	6,394	48	6,447 ^(a)	69	^(b)	70
Liverpool ..	73	4,085	645	4,730	56	9	65

^(a) Including small quantities of English grapes.

^(b) .5 lb.

132. The bulk of the grape sales in London and Liverpool took place in shops stocking both South African and foreign varieties. Glasgow and Birmingham, especially the latter, showed a marked variation in this respect ; by far the largest percentage of the sales were recorded in shops where only South African grapes were stocked.

TABLE 41.—*Distribution of Sales of Grapes between South African and Foreign*

Area.	Total Sales.	Percentage of Total Sales in Shop Stocking		
		South African only.	Foreign only.	South African and Foreign together.
	lbs.	Per cent.	Per cent.	Per cent.
London	23,459	28	5	65
Glasgow	18,229	76	1	23
Birmingham	6,447	96	—	4
Liverpool	4,730	38	—	62

133. Of the shops stocking grapes 80 per cent. were selling less than 100 lbs. per week and nearly 60 per cent. less than 50 lbs.

134. By far the greatest number of shops was in the group selling less than 100 lbs. per week. Within that group more than half the volume of sales was concentrated in the division selling from 50-100 lbs.

TABLE 42.—Percentage of Shops selling various weekly quantities of Grapes (from all sources)

Graduated Sales.	London.	Glasgow.	Birmingham.	Liverpool.	Total.
500 lbs. and over ..	1	6	1	1	2
400 lbs. and under 500	2	4	—	—	2
300 lbs. and under 400	3	1	1	—	2
200 lbs. and under 300	6	2	—	3	4
100 lbs. and under 200	12	12	11	4	11
50 lbs. and under 100	24	19	18	16	21
25 lbs. and under 50	26	27	30	16	26
Less than 25 lbs. ..	26	29	39	60	32
Number of Shops recording Sales.	291	113	92	73	569

135. As in the case of the other fruits independent shops were responsible for the bulk of the sales; nearly 60 per cent. of the total was noted in these shops. Central Stores accounted for just over one-quarter and multiple shops for one-sixth. The percentage of sales of South African grapes occurring in Central Stores was larger than that for foreign, the reverse being the case in multiple shops.

136. The relative position of the various types of shop in the different areas showed much the same characteristics as for the other fruits, the most noticeable difference being that a far higher proportion of the grape sales in Glasgow were made in the Central Stores.

TABLE 43.—Distribution of Sales of Grapes (from all sources) according to Organisation

Type of Shop.	Total Sales Recorded.		Proportion of Total Sales in each Area.			
	South African.	Foreign.	London.	Glasgow.	Birmingham.	Liverpool.
	lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.
Independent ..	24,117	3,979	63	41	92	26
Multiple	6,627	1,861	24	13	1	19
Co-operative ..	525	40	(a)	(a)	5	1
Central Stores ..	12,500	1,194	12	46	2	47
Market Stalls ..	360	10	(a)	—	—	7

(a) Negligible proportion.

137. It is clear from Table 44 that grapes are mainly a high and middle class trade, especially in Glasgow and Liverpool. There is, however, a "hospital trade" in black grapes in all classes and all sizes of shops, and several examples were found of large shops in poorer districts which regularly carried large stocks at moderate prices. The table also shows the tendency for the grape trade to be carried on by large shops irrespective even of the class of trade. For a commodity of so perishable a nature as grapes a large turnover is essential to make stocking worth while; peaches, as already noted, are another example of the same tendency.

TABLE 44.—*Distribution of Sales of Grapes (from all sources) according to Class of Trade and Size of Shop*

Class of Trade and Size of Shop.	Total Sales Recorded.		Proportion of Total Sales in each Area.			
	South African.	Foreign.	London.	Glasgow.	Birmingham.	Liverpool.
<i>Class of Trade—</i>	lbs.	lbs.	Per cent.	Per cent.	Per cent.	Per cent.
High	18,180	2,418	25	67	10	56
Middle	18,539	3,509	55	25	61	31
Low	7,410	1,157	20	8	29	13
<i>Size of Shop—</i>						
Large	30,322	4,174	59	80	64	63
Medium.. ..	10,491	2,022	30	14	29	32
Small	3,316	888	11	6	7	5

Prices

138. The prices recorded for South African grapes, both choice and selected, are summarised in the following table.

TABLE 45.—Retail Prices (per lb.) of South African Grapes

Grade.	No. of Prices recorded.	Extreme Range.	Significant Range.	Most usual Prices.	Average Prices.
Selected ..	530	<i>s. d.</i> 10 to 4 0	<i>s. d.</i> 1 0 to 2 6	<i>s. d.</i> 1 6 & 2 0	<i>s. d.</i> 1 9·2
Choice ..	495	8 to 3 6	10 to 2 6	1 6	1 5·7
Selected and Choice	1025	8 to 4 0	10 to 2 6	1 6 & 2 0	1 7·5

139. The most usual price for both "choice" and "selected" was 1s. 6d. There was a second peak for "selected" at 2s. per lb., which was nearly as significant, but otherwise the price curves were very similar. Except in Liverpool there was little difference in the significant ranges in the areas. Table 46 shows the price distribution.

TABLE 46.—Retail Prices (per lb.) of South African Grapes in each Area

Area.	No. of Prices recorded.	Extreme Range.	Significant Range.	Most usual Prices.		Average Prices.	
				Selected.	Choice.	Selected.	Choice.
London ..	434	<i>s. d.</i> 8 to 4 0	<i>s. d.</i> 10 to 2 6	<i>s. d.</i> 1 6 & 2 0	<i>s. d.</i> 1 6	<i>s. d.</i> 1 9·6	<i>s. d.</i> 1 6·3
Glasgow ..	329	10 to 2 6	—	1 6 & 2 0	1 6	1 8·6	1 6·3
Birmingham.	146	10 to 3 0	10 to 2 6	2 0	1 6	1 9·8	1 3·9
Liverpool	116	1 3 to 2 6	1 4 to 2 0	1 6	1 6	1 9·5	1 5·8
All Areas	1025	8 to 4 0	10 to 2 6	1 6	1 6	1 9·2	1 5·7

140. The lowest price for grapes in Liverpool was 1s. 3d. indicating the tendency of South African grapes in that area to be entirely a luxury fruit. The above table also shows that the average price

for "choice" grapes was lower in Birmingham than in any other area, whereas the average price of "selected" was higher there than anywhere else.

TABLE 47.—*Comparative Price Ranges (per lb.) for South African and other Grapes*

Country of Origin.	Prices Recorded.	Extreme Range.	Significant Range.	Most usual Prices.	Average Prices.
South Africa..	1,025	s. d. s. d. 8 to 4 0	s. d. s. d. 10 to 2 6	s. d. s. d. 1 6 & 2 0	s. d. 1 7.5
Belgium ..	138	2 0 to 6 0	2 6 to 4 6	3 0 & 3 6	3 3.0
United Kingdom.	85	1 8 to 14 6	2 6 to 4 6	3 6	4 0.0
Spain ..	41	4 to 1 6	8 to 1 0	8	10.0
U.S.A. ..	12	1 0 to 4 0	—	1 0 & 1 2	1 4.5
Argentina ..	9	1 0 to 2 0	—	1 9	1 6.0

141. Although there was a slight tendency to a higher price level for South African Grapes in high class shops, the most usual price was still 1s. 6d. per lb. and anything higher than 3s. was exceptional. There was little to distinguish "choice" and "selected," but this was not so when the grades are considered according to the size of the shops. In large shops, the most usual price for "selected" grapes was 2s. and the average price approximately 2s. also, whereas "choice" showed an average and most usual price of 1s. 6d. In medium and small sized shops there was very little difference between the grades, either in average or most usual price. It would appear that only large shops trouble to separate the grades, possibly because of the extra labour it involves and the necessity for larger display and store room.

VIII. SUMMARY

Nature of the Enquiry

142. The report covers two investigations carried out concurrently between January and April, 1932. The first consisted of an enquiry into the condition of South African deciduous fruit on reaching the retailer, and the second was a retail investigation similar to those already undertaken by the Board.

Supplies

143. Both enquiries were mainly concerned with South African peaches, plums, pears and grapes, imports of which have expanded considerably in the past few years, especially since 1927. Though forming only a small proportion of the total yearly supplies, imports from South Africa arrive at a time (between December and May) when the supply position is particularly favourable especially for peaches and plums; pears and grapes are subjected to competition from a number of foreign and Empire countries.

144. This is illustrated in Table 48 showing imports during the 1932 season. It will be noted that while less than 60 per cent. of the grape imports during the season came from South Africa, South African pears constituted less than one third of all pear imports from January to May. During the peak period of the South African supplies, however, competition is less acute as the bulk of the Australian and New Zealand pears arrive in May and of those from the United States in January and early February.

TABLE 48.—*Imports during 1931-32 season*

Fruit.	South Africa.	Australia and New Zealand.	United States.	South America.	Spain.	Belgium.	Total.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Peaches	29,550	—	166	181	—	—	29,897
Plums	31,885	140	—	588	—	—	32,613
Pears ..	91,566	132,089	57,178	16,781	—	—	297,614
Grapes	63,957	8,898	8,622	15,516	9,809	7,214	114,016

Enquiry into the condition of the fruit on reaching the retailer

145. Nearly 22,000 cards covering 18 consecutive weekly shipments were distributed during the course of the enquiry, but less than 10 per cent. were returned by retailers. Cards were received from all parts of the United Kingdom and also from Holland, Belgium, France, Germany, Denmark, Norway and Sweden. The results for peaches, plums and pears, for which the same type of card was used, are summarised in Table 49.

TABLE 49.—*Summarised details of Card Enquiry*

Nature of Enquiry.	Peaches.	Plums.	Pears.
	Per cent.	Per cent.	Per cent.
Unripe	10	18	44
Ripe for Eating ...	85	72	51
Over-ripe	5	10	5

146. The returns for grapes indicated that in 56 per cent. of cases the fruit reached the retailer in sound condition, 34 per cent. had slight waste and dropping, and 10 per cent. had serious waste.

147. The time elapsing between the arrival of the fruit at the port and the opening of the box in the retail shop varied considerably. For peaches from one to 30 days was recorded, but the majority were opened in about 8 days. The range for plums was higher, varying from 2 to 46 days; a fortnight and three weeks were noted in a substantial proportion of cases.

148. In the first six shipments of pears, practically all the fruit was on sale within three weeks; in the second six shipments, however, some of the cards recorded as much as from 44 to 58 days; the last five shipments arrived when Australian and New Zealand pears were on the market and most of the boxes were opened within three weeks of leaving the ship. The bulk of the cases of grapes was opened by the retailer within three weeks.

Scope of the Retail Survey

149. The survey was carried out in two sections, and each shop was visited twice. The investigation covered 865 shops, 439 in London, 136 in Glasgow, 146 in Birmingham and 144 in Liverpool. Nearly 80 per cent. of the total shops were of the independent type, 14 per cent. branches of multiple organisations, 3 per cent. Co-operative Stores and 3 per cent. Central or Departmental Stores.

150. Slightly more than half of the shops were doing a high or middle class trade, and about a quarter of them were large shops, two-fifths of medium size and the remainder small.

Shops stocking South African fruits

151. Fourteen South African fruits were noted during the survey. Five of these—peaches, plums, nectarines, pears and grapes—had a considerable sale, but nectarines were of less importance than the others. Apricots and pineapples were the most important of the remaining fruits, which also included litchies, mangoes, melons, apples, custard apples and passion fruit.

152. At the time of the survey South African peaches and plums were the only supplies on the market, but United States and Argentine pears, and British, Belgian and Spanish grapes offered considerable competition to the South African varieties. In London and Glasgow a high percentage of shops was stocking foreign pears; in Birmingham and Liverpool this competition was much less important. The proportion of shops stocking grapes other than South African, however, was insignificant in areas outside London.

153. Taking the survey as a whole plums were the most widely stocked fruit in London, grapes in Glasgow and Liverpool and pears in Birmingham. Shops stocking plums were more common in all areas than shops stocking peaches, and grapes were more popular than pears, except in Birmingham where competition from foreign pears was less severe.

154. A higher proportion of shops was stocking South African peaches, plums and grapes in Glasgow than in any other area, but Birmingham took first place for pears. As between London and Glasgow this was no doubt attributable to the earliness of the survey in London, where supplies were less plentiful than they later became. On the other hand the time factor does not explain the differences between Glasgow and Birmingham and Liverpool where enquiries were simultaneous.

155. The influence of the time factor is seen if the results are considered for each week. In London the proportion of shops stocking South African fruit increased during the course of the survey, and although less marked than in London itself, the same tendency was apparent, in the areas outside London, where the survey immediately followed. Liverpool resembled London in that a rapid rise in the proportion of shops stocking South African fruit occurred as the season progressed, but in Glasgow and Birmingham the proportion showed much less variation.

156. Table 50 gives figures week by week in London and in other areas combined. It should be noted that these composite figures obscure certain changes as between the different areas other than London. It should also be remembered that the figures cover shops of all classes, and variations in the proportions of the classes in the shops visited from week to week may affect the comparison to some extent. The table should, therefore, be taken as a rough indication only of a position which has been more completely dealt with in the body of the report.

TABLE 50.—*Percentage of Shops stocking South African fruits*

Area.	Week of Survey.	Peaches.	Plums.	Week of Survey.	Pears.	Grapes.
		Per cent.	Per cent.		Per cent.	Per cent.
London ..	1st	46	49	7th	48	53
	2nd	69	76	8th	56	66
	3rd	68	76	9th	60	69
Other Areas ..	4th	38	55	10th	48	60
	5th	48	54	11th	47	62
	6th	65	68	12th	63	75

Average Sales per shop

157. *Sales in Central Stores.*—Although representing about 4 per cent. only of all shops stocking South African peaches, plums, pears and grapes, Central Stores accounted for between 20 and 30 per cent. of the total sales of each fruit in the shops visited by the Board's officers. It is true that these shops were probably much better represented than were other types in the sample visited, but it is nevertheless evident that they are responsible for a relatively large percentage of total sales. Average sales in Central Stores varied from 500 lbs. per week for South African plums to 900 lbs. for South African pears.

158. *Seasonal Trend.*—As already noted in dealing with the proportion of stockists the effect of the seasonal trend has to be taken into consideration. The influence of this factor on the number of selling points was mainly evident in London and Liverpool, but in

regard to sales it was also apparent in all areas with a steadily rising average per shop. Only in Glasgow was there any departure from the general movement, average sales of peaches, plums and grapes in that area only falling in the last week of the season.

159. *Average Sales.*—It is clear from the above paragraphs that in order to present a true picture of average sales in the bulk of the shops, sales in Central Stores must be left out of account, and, further, that the influence of the seasonal trend must also receive consideration. This has been done in Table 51, in which average sales during each week of the survey are shown for London and all the other areas combined. The table is subject to the same limitations as Table 50, and it must be emphasised that it affords only an approximate indication of the general trend.

160. In London the effect of the seasonal factor on average sales per shop was less noticeable than on the number of shops stocking the fruits. The upward trend as the survey progressed was in evidence, but comparison of the figures of the proportion of shops stocking with average sales suggests that increased supplies are disposed of more by an extension of selling points than by larger sales per shop. In Birmingham the proportion of stockists showed little change, but average sales increased sharply, while in Liverpool the percentage of shops stocking and average sales both increased regularly throughout the survey. In Glasgow, where there were more pronounced fluctuations, average sales followed much the same trend as the proportion of shops stocking, the peak occurring in the second week.

TABLE 51.—*Average Weekly Sales of South African fruits (excluding Central Stores)*

Area.	Week of Survey.	Peaches.	Plums.	Week of Survey.	Pears.	Grapes.
		lbs.	lbs.		lbs.	lbs.
London ..	1st	93	100	7th	114	68
	2nd	86	99	8th	123	50
	3rd	119	98	9th	134	64
Other Areas ..	4th	74	52	10th	109	47
	5th	84	63	11th	122	67
	6th	68	73	12th	149	68

Preferences, Volume of Sales and Prices

161. *Preferences.*—The broad and fairly well defined preferences indicated during the survey have been summarised in Table 52. It may be noted, in addition, that the preference for the *Inkoos* variety of peach occurred mainly in London and Birmingham. The liking for *Methley* plums was confined almost entirely to London. Liverpool favoured a smaller plum (50–60) rather than the 41–55 count preferred in other areas. In Glasgow there was a preference for a ripe yellow pear not shared by other areas. The *Hermitage* variety of grape was common in London but not elsewhere.

TABLE 52.—*Summary of Preferences—Variety, Pack and Type of South African fruits*

Fruit.	Variety (in Order of Preference).	Pack or Count Preferred.	Type Preferred.
Peaches ..	Duke of York, Early Alexander, Peregrine, Inkoos, Elberta.	21 to 28 (2 in. to 2½ in)	White flesh—definitely.
Nectarines ..	None specified ..	25 to 28 (2 in. to 2½ in.)	—
Plums ..	Santa Rosa, Kelsey, Methley, Gaviota, Wickson, Apple.	<i>Bulk-packed</i> — Choice 10, 12 and 15 lbs. <i>Trays</i> — 41 to 55 (1½ in. to 2 in.)	Red Plum with red flesh.
Pears ..	Doyenne du Comice, Beurre Hardy, Winter Nelis, Bon Chrétien, Louise Bonne, Beurre Bosc.	<i>Bulk-packed</i> — 160 (2½ in). <i>Trays</i> — 25 (2½ in.).	Fairly firm greenish yellow.
Grapes ..	Waltham Cross, Hanepoot White, Gros Colmar, Hanepoot Red, Rosaki.	—	—

Volume of Sales

162. Total sales recorded have been summarised in Table 53, which gives also, for purposes of comparison, sales of foreign pears and grapes. The two main features of interest in the table are the comparatively high proportion of sales of foreign pears and grapes in London, and the generally low level of sales in Liverpool.

163. As regards the first point it will be noted that in London recorded sales were higher for foreign than for South African pears while the proportion of foreign grapes sold was considerably greater than in other areas. In Liverpool sales of all fruits were appreciably below sales in Glasgow and Birmingham with which they may be compared. As regards pears this was clearly not due to foreign competition since sales of South African pears were nearly four times as great as sales of foreign varieties. Similar considerations apply to grapes.

TABLE 53.—*Distribution of Sales according to Area*

Area.	No. of Shops visited.	Peaches.	Plums.	Pears.			Grapes.		
				South African.	Foreign.	Total.	South African.	Foreign.	Total.
		000 lbs.	000 lbs.	000 lbs.	000 lbs.	000 lbs.	000 lbs.	000 lbs.	000 lbs.
London..	439	35·8	33·7	27·1	35·2	62·6 (a)	16·1	5·7	23·5 (b)
Glasgow	136	12·0	7·7	20·4	9·2	29·6	17·6	·6	18·2
Birmingham.	146	5·3	7·4	13·6	1·3	14·9	6·4	(c)	6·4 (b)
Liverpool	144	3·4	3·6	8·3	2·3	10·6	4·1	·6	4·7

(a) Including small quantities of Canadian and Australian Pears.

(b) Including small quantities of English Grapes.

(c) Under 50 lbs.

164. In London over half the sales of pears took place in shops selling both South African and foreign fruit. In Birmingham, on the other hand, nine-tenths of sales were recorded in shops selling

only South African pears. An even greater proportion of total grape sales in London occurred in shops selling South African and foreign varieties, and in this respect Liverpool was not far behind, though clearly average sales of foreign grapes in these shops were comparatively small. In Glasgow and Birmingham by far the greatest volume of sales was in shops stocking South African grapes only.

Sales in Different Types of Shop

165. *Organization.*—In considering combined sales in all areas as set out in Table 54 it must be remembered that the proportion of multiples to total shops visited was high in Liverpool and low in Birmingham. It must also be borne in mind that Central Stores were probably over-represented.

166. Over 50 per cent. of the sales of all fruits took place in independent shops, but it will be noted that the proportion of the sales in these shops was highest for plums and lowest for peaches; the latter, being a relatively expensive fruit, sells rather more freely through Central Stores. Foreign pears and grapes, particularly pears, sold best in independent and multiple shops; in Central Stores the proportion was much lower than for the South African fruit.

TABLE 54.—*Distribution of Sales according to Organization*

Type of Shop.	Proportion of total Shops visited.	Peaches.	Plums.	Pears.		Grapes.	
				South African.	Foreign.	South African.	Foreign.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Independent ..	79	51	59	58	71	55	56
Multiple ..	14	19	17	15	22	15	26
Co-operative ..	3	1	2	2	1	1	1
Central Stores	3	28	20	23	5	28	17
Market Stalls ..	1	1	2	2	1	1	(a)
	100	100	100	100	100	100	100

(a) Negligible proportion.

167. *Class and Size of Shop.*—Peaches were more definitely a high class trade than the other fruits in the areas as a whole, but in Glasgow and Liverpool all the fruits were found in a higher proportion of high class shops than in London and Birmingham. Tray plums were more frequently sold in high class shops, but plums generally were more popular in middle and poor class shops than the other fruits. The main demand for South African pears came from shops in high and middle class districts, but foreign pears were sold in relatively greater proportions in middle and low class shops. This is clear from Table 55, from which it will also be noted that the proportion of sales of peaches and grapes in large shops was greater than for the other fruits. This may be attributed to the perishable nature of those fruits which require an assured demand, such as is offered by the larger shops, before stocking can be undertaken.

TABLE 55.—*Distribution of Sales according to Class of Trade and Size of Shop*

Class of Trade and Size of Shop.	Proportion of total Shops visited.	Peaches.	Plums.	Pears.		Grapes.	
				South African.	Foreign.	South African.	Foreign.
<i>Class of Trade—</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
High.. ..	7	44	32	38	13	41	34
Middle	44	44	50	42	57	42	50
Low	49	12	18	20	30	17	16
<i>Size of Shop—</i>							
Large	23	71	67	64	47	69	59
Medium	41	23	25	26	36	24	28
Small	36	6	8	10	17	7	13

Prices

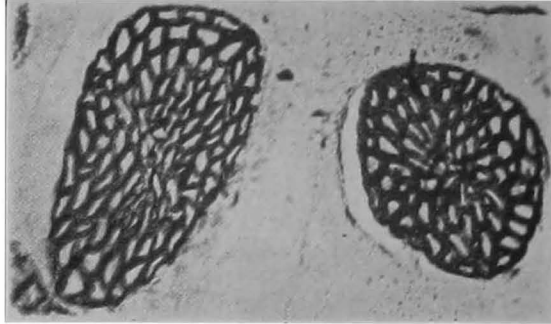
168. The range of retail prices for the four principal fruits recorded in the areas taken as a whole, with average prices, have been summarised in Table 56. These figures cover all grades and sizes, and are, therefore, of interest mainly for broadly comparative purposes. The number of price records for each fruit has been added (in brackets) to the table.

TABLE 56.—*Summary of Retail Prices recorded for South African Fruits in all Areas*

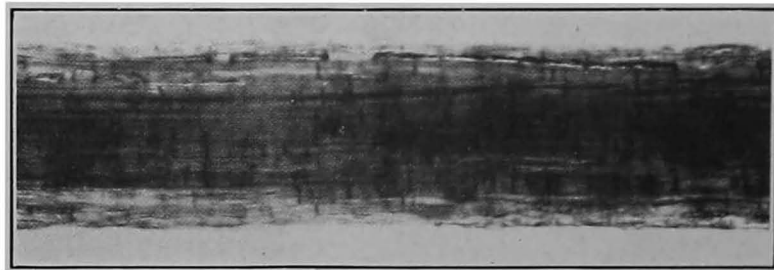
Description.	Peaches (725)		Plums (738)		Pears (543)		Grapes (1,025)	
	Each.		Per lb.		Each.		Per lb.	
	<i>d.</i>	<i>s.</i> <i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>	<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>
Extreme Range	1½	to 1 3	4	to 1 1	1	to 4	4	to 1 6
Significant Range	2	to 6	5	to 10	1	to 3	5	to 10
Most usual Prices	<i>d.</i>		<i>d.</i>		<i>d.</i>		<i>d.</i>	
	2½	& 3	6	& 8	1½	& 2	6	& 8
Average Prices	3	·3	7	·1	1	·9	7	·6
							2	·8
							1	6 & 2 0
							<i>s.</i>	<i>d.</i>
							1	7·5

169. Prices for United States and Argentine pears sold by the pound were on the whole slightly lower than prices for the South African fruit, the average being 7·0*d.* and 6·7*d.* respectively. Sold individually there was little difference.

170. The general level of prices for South African grapes was much lower than the prices at which some of the competing varieties were selling. The average for English and Belgian hot-house grapes was 4*s.* and 3*s.* 3*d.* per lb. Grapes from the United States averaged 1*s.* 4½*d.* per lb., and Spanish grapes 10*d.*



Cross-section of two coir fibres
magnified 200 diameters.



Coir fibre magnified 400 diameters.



COIR

Report on the Attributes and Preparation of
Coconut Fibre

By

S. G. BARKER, Ph.D., D.I.C., F.Inst.P.,
M.I.Chem.E., F.R.S.E., F.Z.S., F.T.I.



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PREFACE

Nearly four million acres of land in the Empire are devoted to coconut cultivation. From the agricultural point of view the cultivation of the coconut has received a great deal of attention, but the depression from which the industry at present suffers suggests the need, as in the case of sisal, for a programme of research designed to embrace not only the agricultural problems, but the exploration of industrial possibilities by the development of new uses for the fibrous products of the coconut palm. A most important product is the fibre or coir extracted from the husk.

The present report by Dr. S. G. Barker represents an attempt to study the qualities and uses of coconut fibre on a scale commensurate with the importance of the product. Dr. Barker, besides reviewing the attributes of the fibre and the existing methods of retting and extraction, directs attention to some of the many uses to which it could be put if properly treated and rendered suitable for modern requirements. The fact that coir, properly treated, resists decay, is not disintegrated by bacteria nor harmed by water, and can be easily impregnated with bituminous and resinous materials provides a unique opportunity for exploiting its uses in directions hitherto untried in commerce or industry; but, as Dr. Barker points out, modern industry must have a scientific foundation and the fundamental characteristics of coir must be explored by scientific research if, as with coconut oil, knowledge is to be yielded for its development in new directions.

I am confident that this report will not only prove of considerable interest and value, but will stimulate research into the possibilities of the greater utilisation of coir.

It should be mentioned that this report is the result of Dr. Barker's private study of coir and embodies the findings of a number of Research Workers who have associated themselves freely and voluntarily with him.

PLYMOUTH.

*Chairman of the Research Grants
Committee.*

Empire Marketing Board,
26th August, 1933.

COIR OR COCONUT FIBRE

To the traveller who has approached tropical portions of our Empire by sea, memories of coconut palms, beneath which nestle the houses and huts of the native populations, flit across his mental vision. To the tropical dweller himself, the coconut palm supplies his food, clothing, habitation, domestic utensils, as well as being his source of livelihood from the sale of its products as a raw material for industry.

Every part of the tree is utilised and there is small wonder therefore that the coconut palm has been given the pseudonym of "The Consols of the East". Tradition, legend and customs are associated with the coconut, varying locally in subject and association. In certain districts the birth of a child is celebrated by the planting of a coconut palm, and it is believed that a mysterious relationship exists between the development of the human life and the growth of the palm, a belief enhanced by the fact that the usual span of the former corresponds to the period of life of the latter. What of the products and uses of the coconut palm? Let us outline them carefully.

- (1) *The tree trunk* may be used,
 - (a) The hollowed trunk for water pipes.
 - (b) The wood for fuel or door and window posts.
- (2) *The leaves* may be used for—
 - (a) Manufacture of roofing materials when interwoven, e.g. the "Cadgan" of S. India and Ceylon.
 - (b) The central rib of the fronds as the bristles of brooms.
 - (c) The dried leaves furnish fuel.
- (3) *The blossom*.—The flower stalk when bruised and incisions made, yields a saccharine juice which when fermented becomes "toddy" or alternatively can be utilised for the production of sugar.
- (4) *The nut* may be considered under the following headings.
 - A. *The Husk*.
 - i. Retting the husk and extraction of fibre.
 - ii. Utilisation of the residue.
 - iii. Subsequent manufacturing processes, manufacture of yarn, matting, etc., dyeing, bleaching, etc.

B. *The Shell.*

i. Utilisation of the shell by destructive distillation, yielding :—

(a) Vegetable charcoal.

(b) Acetic acid.

(c) Tarry residue.

ii. Utilisation as cups for rubber latex collection and domestic utensils, buttons, etc.

iii. Utilisation of the waste products yielding gas to work the manufacturing plant, or for copra drying.

iv. In polished form for ornamental purposes.

C. *The Kernel.* Production of copra.

(a) Copra drying.

(b) Oil expression.

(c) Desiccation.

(d) Cattle cake. (Poonac of S. India and Ceylon.)

5. *The Roots* are often used medicinally as an astringent.

In the present discussion an attempt will be made to show that the above items are really closely related into one continuous series of manufacturing processes, interdependent on each other, and how unity of treatment and continuity of processes of manufacture will lead to a great economic saving. In the past, the industry being largely in the hands of the individual ryots as a cottage industry has largely militated against continuity, but in the case of large estates, and composite areas devoted to coconut cultivation this need no longer be a deterrent. Co-operative organisation might do much for the former and in the case of the latter, it would seem to be only essential that better methods should be indicated. One fact is paramount in dealing with the husk, namely, that almost one-half of the husks available to-day are left unused owing to lack of retting facilities.

From the agricultural point of view, the cultivation of the coconut palm has received a great deal of attention from the Departments of Agriculture in the tropical districts where it is found; but the development of the subsequent industrial processes for the utilisation of its products has been largely left to the initiative of those dealing in these commodities who, in the past, have found that under the economic conditions prevailing, manual methods of extraction and recovery of the fibre, etc., have proved profitable.

It is the old story of an industry which sails along on an even keel in the comparatively placid waters of commercial security, drawing for its development and propulsion upon the motive and directive power of its own experience. Suddenly, an "economic blizzard" strikes the craft. No longer can the ship of industry be guided by the usual rules under storm conditions. There must be keen perception and quick alteration of tactics to meet the new conditions which have arisen, if wreckage is to be avoided.

It will be generally admitted that the world's industry has, since the War, developed largely on a chemical and scientific basis. The advent, for war purposes and subsequent development in times of peace, of cellulose products, has undoubtedly revolutionised the position of old-established commodities on the modern market, and coconut fibre, or coir, in common with many other commercial materials, has felt the repercussion of such competition. In an article in the "Engineer" of June 12th, 1931, the following statement appears :—"At present the whole year's production of coir fibre for spinning is about three and a half million tons. Actually only a hundred thousand tons are used, the remainder being wasted owing to the fact that no commercial use can be found for it." There is, therefore, an abundance of the raw material, and the future of the industry would seem to lie in finding new uses for the fibre and carrying out research work to discover if it can be rendered comparatively cheaply into forms more favourable for utilisation in other directions than those at present. As far as the Empire is concerned, the principal exporting countries are Ceylon and India, but small quantities are exported from the Federated Malay States and there is a very small export of coir manufactures from Tanganyika and Zanzibar. Malaya as a whole is an importer of coir fibre and manufactures. As regards foreign countries, the trade returns of the Dutch East Indies do not differentiate between the coconut and other fibres, but the German import returns show a small import of coir from this source. There is also a moderate export of coir fibre from the Philippines.

Broadly speaking, Ceylon is the largest exporter of the raw fibre while India (besides being an importer of raw fibre) exports very large quantities of manufactured coir products. The Indian trade returns do not differentiate between coir yarn and other types of manufacture, and exclude coir rope and cordage but both in the case of Ceylon and of India, coir yarn comprises the bulk of the coir

manufactures exported. The following tables show the principal exporting countries during the period 1928-30 and distinguish between unmanufactured and manufactured fibre.

I. *Domestic Exports of Coir Fibre.*

	<i>Thousand cwts.</i>		
	1928.	1929.	1930.
Ceylon*	569·2	595·4	481·1
Philippine Islands ..	(a)	59·7	1·1
India	5·8	5·0	5·3

II. *Domestic Exports of Coir Manufactures* (excluding rope and cordage).

	<i>Thousand cwts.</i>		
	1928.	1929.	1930.
Ceylon(b)	93·7	101·4	105·5
India(c)	654·8	609·3	650·7

III. *Exports of Coir Rope and Cordage from Ceylon.* (Indian figures not available.)

<i>Quantity.</i>	1928.	1929.	1930.
Thousand cwt.	19·1	15·0	11·9

Grove Palmer (American Dyestuff Reporter, December 9th, 1929) gives the following figures for the year 1928 regarding the coir industry of the Malay States :—

“ In the coconut growing parts of the Malay States, where there are something like one-half million acres of ground given up to the cultivation, producing approximately a million tons of fibre, we are

(a) Not separately distinguished.

* Includes exports of coir bristles :—

1928.	1929.	1930.
<i>Thousand cwts.</i>		
182·2	200·0	171·2

(b) Includes exports of coir yarn :—

1928.	1929.	1930.
<i>Thousand cwts.</i>		
92·2	100·6	104·4

(c) Imports of coir and manufactures :—

<i>Unmanufactured.</i>			<i>Manufactured.</i>		
1928.	1929.	1930.	1928.	1929.	1930.
<i>Thousand Cwt.</i>			<i>Thousand Cwt.</i>		
16·2	17·2	14·8	1·6	1·3	0·9

officially informed that the quantity of coir used is negligible ; a small amount is converted into yarn and other goods in the gaols, and this is sold locally. Of that which is made in factories, the following quantities are exported, mainly to neighbouring countries :—

For the year 1928—

	<i>Pounds</i>
Fibre	41,400
Ropes, twine, etc.	3,900,800
Mats, matting, etc.	4,068,704

Oddly enough, the same States import from the countries to which the above commodities are sent the following quantities of the same :—

	<i>Pounds</i>
Fibre	699,600
Ropes, etc.	10,578,800
Mats, matting, etc.	8,791,216

In their "Survey of Oilseeds and Vegetable Oils", Volume II, "Coconut Palm Products", the Empire Marketing Board have quoted figures in Table 137 giving the estimated area under coconut cultivation in the Empire. It is of interest to reproduce that table here.

Table 91 of the same publication by the Empire Marketing Board quotes interesting figures regarding the foreign trade of the United Kingdom in miscellaneous coconut palm products. It is again of interest to reproduce their table in so far as it affects Coir fibre, yarn, mats and matting.

The industry is therefore one of considerable Imperial importance, a fact which is emphasised when it is considered that the total area of land in the Empire devoted to coconut cultivation in 1930 was given as being nearly four million acres, being about 53 per cent. of the total coconut area of the world. In India and Ceylon, the production of coir from the husks is to a considerable extent a cottage industry with the natural consequence that in dealing with a small unit, each ryot has recourse to methods which, in the light of modern science, may seem inefficient and uneconomic, yet which even now are profitable. The question arises as to whether these methods could be rendered more remunerative by scientific development.

TABLE 1.—*Estimated Area under Coconuts*

Countries.	1921.		1930.	
	Acreage (in millions of acres).	Percentage of total of acreage.	Acreage (in millions of acres).	Percentage of total acreage.
<i>British Empire countries—</i>				
India (a)	1.2	21	1.4	20
Ceylon	0.8	14	1.1	15
British Malaya	0.4 (b)	7	0.6	8
British South Sea Islands (c)	0.4	7	0.6	8
British West Indies	0.1	2	0.1	1
British Borneo, Kenya and other British countries ..	0.1	2	0.1	1
Total	3.0	53	3.9	53
<i>Foreign countries—</i>				
Dutch East Indies (d)	1.1	20	1.5	21
Philippine Islands	1.1 (e)	20	1.4	20
Foreign South Sea Islands(f)	0.2	3	0.3	4
Siam	0.1	2	0.1	1
Mozambique, French Indo- China and other foreign countries	0.1	2	0.1	1
Total	2.6	47	3.4	47
Grand Total	5.6	100	7.3	100

- (a) Excludes a number of Indian States, data for which are not available.
 (b) Based on the acreage for 1924 shown in Table 20.
 (c) Excludes Cook Islands for both years and native reserves in New Guinea for 1930, the data not being available.
 (d) Estimated on the basis of the official figure for 1917 (949,000 acres).
 (e) 1923.
 (f) Estimated on the exports from the whole group, and the exports from, and acreage in the Japanese Mandates.

Note.—The aggregate estimates compare fairly well with an estimate given in "Copra and Coconut Oil," by K. Snodgrass. Writing in April, 1928, and therefore referring presumably to 1926, the author states, "On the basis of data obtained from official documents and by direct application to government representatives in the tropics, it appears that the area devoted to the cultivation of the coconut palm is probably not much more than 6 or 6½ million acres."

TABLE 2 (E.M.B. Table 91).—*Foreign Trade of the United Kingdom in miscellaneous Coconut Palm Products*

Product.	1909-13 (aver- age).	1924.	1925.	1926.	1927.	1928.	1929.	1930.	1931.
Coir fibre and yarn :—	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Imports—									
India	12,496	20,494	23,794	18,187	18,308	21,675	22,352	22,927	20,571
Ceylon	3,777	8,382	8,439	6,883	7,032	5,854	5,580	5,857	8,274
Other countries ..	236	486	487	636	1,543	714	1,772	726	394
Total	16,509	29,362	32,720	25,706	26,883	28,243	29,704	29,510	29,239
Exports and Re-exports..	3,866	14,840	16,602	13,023	13,658	15,224	15,832	16,535	15,647
Net imports.. ..	12,643	14,522	16,118	12,683	13,225	13,019	13,872	12,975	13,592
Coir mats and matting :—	000's	000's	000's	000's	000's	000's	000's	000's	000's
	sq. yds.	sq. yds.	sq. yds.	sq. yds.	sq. yds.	sq. yds.	sq. yds.	sq. yds.	sq. yds.
Imports—									
India	} (a)	3,069	3,064	3,739	4,046	3,801	4,572	4,766	5,332
Other countries ..		734	836	699	1,245	1,531	1,564	1,341	1,231
Total	(a)	3,803	3,900	4,438	5,291	5,332	6,136	6,107	6,563
Exports and Re-exports..	(a)	229	209	285	256	312	352	331	243
Net imports.. ..	(a)	3,574	3,691	4,153	5,035	5,020	5,784	5,776	6,320

(a) Not available.

(b) Included in " Other countries."

The Palm

Many species of cocos are known in the group of monocotyledons which includes the coconut palm. *Cocos nucifera* is at present found growing naturally in the eastern as well as the western hemisphere. The members of genus cocos growing in cooler climes remain small in stature, but the coconut palm grows with true tropical luxuriance to a height of 50-100 feet with a stem diameter of 18 or more inches. It is curious that in the last fifty years this palm became so important to the rest of the world. In Europe and America the present generation was the first to learn the uses of the cocos palm products, such as margarine and other vegetable fats, palm oil soap, and of mats, brushes and other things made of the fibre. This was accompanied by a revival and extension of the palm culture in the tropics, and in a short time copra, the dried endosperm of the coconut, became the chief export product of native agriculture in the Dutch East Indies, and afterwards from the Philippines, Ceylon, British India, some islands of the West Indies, and from some parts of Africa.

Cocos nucifera has become almost entirely a cultivated palm. As a monocotyledonous plant the palm has no taproot and no side branches ; it has no massive trunk which can be sawn into planks, it does not grow in thickness, but only in length, it has only 20 or 30 leaves at a time and they are all in a tuft at the top. The roots, growing in a circle round the foot, become strong and fairly thick, but do not go very deep into the ground. The trunk or stem of this palm is a hard casing with a spongy substance, through which the sap is drawn upwards. The hollow centre of old palms, when the filling has been removed, is so large, that such stems are often used as water-pipes. The scars left on the stem, where the old leaves have fallen off, give it a rough appearance.

Old palms grow thicker at the base in consequence of the pressure exerted by the weight of the continually lengthening stem. The leaves at the top are from fifteen to twenty feet in length ; they have a thick mid-rib with from 60 to 80 pairs of long and narrow leaflets all along it, each of these may be 20 inches or so long and also have strong mid-ribs. The cocos palm therefore has a feather-like leaf. The enormous inflorescence takes place in the axis of the leaves and is at first enclosed in a sheath, but this dries up and falls off. The inflorescence may be six feet long and male and female flowers appear in the same inflorescence ; fertilisation takes place by means of insects and the wind. Each flower is in itself not large, but there are many of them. After fertilisation the male flowers fade and drop off and a year later the heavy fruit may be seen in the tops of the palms.

In describing the inflorescence and the subsequent fruit the Bulletin of the Imperial Institute may be quoted :—“ The flowers are produced on a branched spadix, which in its young state is enclosed in a tough tubular spathe situated in the axil of a leaf ; they are unisexual and both pistillate and staminate flowers are borne on the same inflorescence, the former being situated towards the base of the branches. The perianth consists of three outer and three inner segments of a yellow or greenish-yellow colour ; the stamens number six ; the ovary is three-celled, but at an early stage of development two of the cells become abortive, and only one finally matures.

“ The fruit is a drupe, usually three-sided with rounded angles, more or less ovoid in outline, but varying considerably in shape according to variety. It takes nearly a year to arrive at maturity and then measures 10 to 12 inches or more in length by about 10 inches in breadth. The outer husk is usually bright green in colour, but some

varieties produce yellow, red, bluish-brown or black fruits. In cross section the fruit is seen to consist of four distinct layers—the thick fibrous mesocarp, which is situated just below the outer skin or epicarp, the endocarp or shell of the nut ; and the white endosperm which is usually spoken of as the kernel or 'meat'. The hard shell of the nut is marked with three 'eyes' that correspond to the three carpels of which the fruit is composed. The embryo, which under favourable circumstances develops into a young palm, is situated just beneath the largest of the three 'eyes'. In the early stages of development the cavity of the nut is filled with water, and the kernel is of a creamy consistence. As the fruit ripens some of the water is absorbed and the kernel becomes firm in texture. When mature the watery contents of the nut only partly fill the cavity and may be detected by shaking. At this stage the fruit is considered fit for gathering for use as food or for the preparation of copra. A green fruit, the total weight of which is about 3 kilos. (6½ lb. approximately) has the following percentages of component parts :—Husk 30·6, shell 10·0, fresh kernel 29·4, water 30·0."

Lekkerkerker gives the following figures for the weight of the nut :—" A fully ripe fresh coconut weighs from 4 to 5 lb., this weight being accounted for as follows :—Husk 35 per cent., shell 13 per cent., kernel 30 per cent., and the milk 22 per cent."

Habitat of the Coconut Palm

The coconut palm grows well on coasts consisting of mostly coral sand with a large proportion of common salt in the soil. It is not readily liable to disease, but needs much sun, water and warmth.

The best soil is that found in the alluvial flats along large streams which are not liable to excessive or prolonged floods, but excellent results are obtained in deep sandy or gravelly loams. At the end of the fifth year after planting the plant possesses a definite trunk and when nine or ten years old begins to bear fruit abundantly. Pests such as boring beetles, rats, flying foxes and squirrels do considerable damage by feeding upon the young nuts and also upon the terminal bud or "cabbage" (Vide Bulletin of Imperial Institute, Vol. III. No. 3, 1905).

According to Lekkerkerker it does not live where the annual rainfall is less than 50 inches, and to prosper exceedingly well it should have at least 75 to 100 inches of rain per annum, unless either by artificial irrigation or some other natural supply, such as rivers or

backwater lagoons, an ample supply of water is assured. In places where the average annual temperature is less than 75° F., the tree does not thrive and at altitudes above 2,650 feet or so the fruit does not ripen. The Bulletin of the Imperial Institute states that being essentially a tropical palm, whilst it can grow up to the 25th degree, north or south latitude, it rarely ripens fruits in the extreme limits of this region. It definitely thrives with an average mean temperature of 80° F. and a rainfall between 60 and 80 inches.

It is not intended in the present work to deal with the subject of copra, except in passing, but to confine one's attention to the fibre obtained from the husk of the nut, and suggest methods for its more rapid recovery, better treatment and in consequence indicate some new uses thus rendered possible.

Maturity of the Nut

The question of the maturity of the nut best suited for the extraction of coir fibre is one about which there has been considerable controversy. It has to be remembered that copra in most cases is the main quest and possibly the degree of ripeness of the nut for obtaining good coir may not coincide with that for obtaining the best yield of copra.

There has not been any real proper investigation on this point but on the other hand it is stated that the greatest quantity and the best quality of coconut oil is most easily and cheaply produced from copra obtained from nuts gathered when fully ripe.

The Bulletin of the Imperial Institute, which apparently gathered its information from Ceylon, states "For the preparation of Coir the coconuts should be gathered before they are quite ripe. The fibre becomes coarser as the nuts ripen and then requires to be soaked for a longer period in order to free it from the corky tissues with the result that the coir acquires a dark colour."

According to information communicated by Sampson on the West Coast of India it is generally accepted that "good quality Coir is made from the husks of ripe nuts which have been harvested before the husk has ripened and dried."

Copeland states that "as the ripening of the nuts goes on, the coir becomes exceedingly lignified and so dark, harsh and brittle that its value decreases very materially."

Fowler and Marsden in dealing with this question state that their "experiments indicate that the riper the nut the less dense is the mesocarp and the more easily it is resolved and the fibres separated.

Comparative experiments showed that the extraction of the colour-producing principles was more rapid, and discoloration of the fibre correspondingly less, with a ripe husk than with an unripe one.

The change in weight and chemical composition of the coconut is summed up in the following table of the results of analysis of San Ramon Nuts by Walker, as quoted by Copeland in his book :—

“ The table gives the weight of each part of a nut and the percentage of the whole nut. The figures are averages, based on the number of nuts indicated at the head of each column :—

TABLE I.—*Analysis of San Ramon Nuts, by Walker*

	Sea-shore 1000.		Inland 1000.		From one tree					
					Hardly ripe, 10.		Fairly ripe, 9.		Dead ripe, 10.	
	gms.	%	gms.	%	gms.	%	gms.	%	gms.	%
Husk ..	897	38.0	703	30.8	2,779	70.0	1,268	51.1	520	33.4
Shell ..	282	11.9	291	12.7	227	5.8	214	9.4	201	12.9
Meat ..	647	27.4	688	30.1	405	10.3	465	20.6	453	29.1
Water ..	537	22.7	603	26.4	547	13.9	437	18.9	384	24.6
Total ..	2,363	100.0	2,285	100.0	2,958	100.0	2,384	100.0	1,558	100.0

Choudary effects an interesting comparison of Walker's analyses of San Ramon “ dead ripe nuts ” and of Malabar nuts by Norris. These are shown in Tables II and III below, and also the chemical composition :—

TABLE II

	San Ramon nuts (Walker)			Malabar nuts (Norris)		
	Gms.	% on total.	% on total (disregarding water).	Gms.	% on total.	% on total (disregarding water).
Husk	520	33.3	44.2	329	37.7	42.6
Shell	201	12.9	17.1	145	16.6	18.8
Meat	453	29.1	38.7	298	34.1	38.6
Water	384	24.6	—	101	11.6	—

TABLE III

	San Ramon nuts (Copeland).			Malabar nuts (Norris).		
	N. %	K ₂ O %	P ₂ O ₅ %	N. %	K ₂ O %	P ₂ O ₅ %
Husk	23.2	53.4	0.8	18.3	66.7	18.6
Shell	9.5	12.9	20.7	6.6	3.7	1.5
Meat	63.3	33.7	78.5	75.1	29.6	79.9

Choudary remarks then " the experiments of Fowler and Marsden indicated that the husk from unripe nuts gave a dull coloured fibre and took longer to ret. It seems to be clear that the best way to harvest the nuts for the production of good coir is to permit them to ripen on the tree until they fall."

At the same time this statement must be accepted with caution for as yet no really definite confirmation of the degree of maturity necessary for the extraction of good coir is available.

On the other hand it is claimed that by methods of chemical retting the ripeness of the nut and the time in which it has been in storage is immaterial. Here again this remains to be proved, but it is certain that excellent results have been obtained with nuts gathered in Ceylon and India and stored for as long as six months after being transported to this country.

Harvesting the Crop

Closely allied with the question of maturity there is the question of the methods of harvesting the nuts on their removal from the tree. In South India and also in other places where the nuts are plucked in the unripe state, they are cut down by climbers who ascend the trees with the aid of notches cut in the trunk or by means of a short girdle which they wrap round the ankles so as to give them a grip round the tree trunk. In districts of South India where such methods of harvesting prevail, fully dried fruit are seldom seen, and in general the coir industry flourishes in such localities. The climber gauges the ripeness of the bunch of nuts by tapping one of the fruits with his nail, the sound thus emitted affording a gauge of the amount of moisture in the husk, i.e. the degree of maturity of the fruit. If

ready, the whole bunch is cut. If methods are found for the production of good coir from dried nuts, then a great labour problem will be solved, for owing to the laborious nature of the work of climbing and the small remuneration attached to it, of economic necessity, the supply of climbers is becoming smaller and smaller as time goes on. On the other hand, if unripe nuts are required for the best grade coir, and cutting from the tree is necessary, then in many places a complete revision of existing practice would be essential.

In Malaya, for example, no fruits are harvested until they are dead ripe and in many other places where labour is scarce and expensive, nuts are only collected from the ground when they are fully ripe and have fallen from the tree. Labour which can climb trees is, in many places, not available, and in any case the method of cutting is more expensive than letting the nuts ripen and fall naturally. It is essential therefore, in face of these facts, that the question of retting should be examined to see if the ripe nut could be made to yield coir as good as the green variety.

It must be borne in mind, however, that two methods of approach to this problem are open :—

- (1) the improvement of cottage retting methods,
- (2) the introduction of retting upon a factory basis for large quantities, and by chemical methods.

In any case it will be best at this stage to process from the harvested nut and to examine the products therefrom as recovered. Obviously, the removal of the husk is the first step.

Removal of the Husk or opening the Nut

The manner at present adopted by the natives is to have an iron or wooden spike or sharpened stake stuck rigidly in the ground. The point of the stake is struck by each nut in such a manner that the force of the blow causes the point to penetrate the husk. This penetration splits the husk away from the nut into two or three parts, which are readily separated. One worker treats about 1,000 to 1,500 nuts per diem in such a manner. In other places the splitting is done by means of a peculiarly shaped iron tool almost like a chopper, the worker remaining seated on the ground and chopping each husk open individually.

Machines are available for this purpose (*vide* Larmuth and Bulmer, Ltd., Manchester, and Fairbairn Lawson Combe Barbour, Ltd., Leeds). The complete nut is placed in a hopper over the centre of

the machine and as it passes through it is divided into three portions by the circular cutters or millers. The blades of the cutters cut right through the husk, shell and nut, all of which fall beneath the machine and are then separated each away from the other. The husk is now ready for retting, and the kernel for separating the shell to be made into copra.

Copeland records that in Samoa, it is customary to split the entire nut, husk and all, at one and the same time.

Choudary states that the splitting of the nuts on the West Coast of India occurs not later than four days after they are plucked from the tree, during which time they are kept in the shade. On the other hand, on the East Coast the nuts may be stored for months before splitting.

The husk, split by striking against a sharp flat edged wooden spike, is usually separated into four pieces. It is said that iron spikes tend to discolour the fibre, but nevertheless they are frequently used. The split husks must be kept in the shade and not exposed to the weather, but soaked with as little delay as possible. If dried before soaking, or wetted by rain, discoloration of the fibre results.

The whole of the fibre is thus usually removed except the short and little fibres at the upper end of the nut covering the three eyelets.

Where coconuts are a plantation crop the nuts are usually husked in the field, except perhaps when water transport is readily available. Husking has not been an expensive job by manual labour and possibly a husking machine would not be more economical, considering the present distribution and conditions of the industry. Although in India 1,000 to 1,500 nuts are usually a day's work, Sampson records that in the West Indies the husking of 2,000 nuts per diem has been regarded as a daily task. He further states that the unhusked fruit occupy in bulk about $4\frac{1}{2}$ times the space of husked nuts and from the point of view of weight the unhusked fruit may be from 60 per cent. to 112 per cent. more than the husked.

On the West Coast of India the yield of fibre from 600 nuts is roughly one hundredweight. This number will vary somewhat in other countries as the thickness of the husk is a very variable quantity. Some of the West Indian strains of coconuts have, for example, a thin husk while those of East Africa have a very thick husk. The size of the fruit also varies greatly according to the fertility of the soil and variety grown. Working on Indian figures, however, it can be taken that the annual crop from an acre would give 5 cwt. of coir

fibre, i.e. the crop from 3,000 nuts. The capacity, prior to chemical retting, of a machine for the preliminary crushing of the husks is given as 8,000 a day, i.e. the total crop for the year from about 2½ acres. Six harvests a year would be necessary if the husk has to be green for fibre extraction ; thus for one harvest this machine would have to deal with the crop from about 15 acres each working day. It is obvious therefore that in many places the cost of transport is of vital importance to a scheme of chemical retting on any large scale, except perhaps where water transport is available.

Before proceeding further let us recapitulate the several parts of the opened nut as now exhibited.

Outside is the husk, then the shell and inside this the kernel. The outer skin is a thin, leathery, waterproof "epicarp" (epidermis or outer skin), by means of which flotation on water is possible, whilst the nut retains its living properties or potentialities for germination unaffected. Immediately beneath the skin comes a thick "mesocarp", consisting of a mass of fibres called "coir", between which is a mass of cork-like substance which ultimately becomes the coir dust. Fowler and Marsden state that the word "coir" is the translation of "kayira", meaning rope.

The very hard shell, about one-eighth of an inch thick, forms the "endocarp" and encloses the seed. The seed is composed of a thin brown skin, enclosing the white endosperm or oleaginous white "meat" (when dried known as copra), around the embryo, which is very small. The hollow of the nut contains the coconut milk, which, in the case of absolutely ripe fruit has become "water", the fats having been largely absorbed.

The hard shell of the nut is marked with three eyes that correspond to the three carpels of which the fruit is composed. The embryo, which develops into the young palm, is situated beneath the largest of the three "eyes".

We now come to the crux of the whole fibre question, namely, how is the separation of the fibre from the husk to be effected?

Separation of the Fibre from the Husk

It has become an axiom amongst those workers engaged in scientific investigation of industrial processes and practice that there is always a good scientific basis for established industrial practice even though this may be unknown to those actually performing the several functions of the process itself. Thus, when one considers the question of soaking and retting of the coconut husk in the tropics, although at

first sight there may seem to be somewhat haphazard methods employed, yet closer observation will probably reveal that there is reason for each and every part of the performance. Let us therefore first of all review the various methods utilised at present for soaking the husks and then later study the question from the point of view of more recent discoveries in modern science and industry.

Soaking

Choudary, in his excellent and critical review of the various factors regarding the retting of coconut husks outlines very lucidly the methods used for soaking of coir on the West Coast of India.

(1) The husks are usually soaked in pits by the side of the backwaters, which are provided with a channel to allow the water to flow in and out according to the state of the tide. To accommodate 1,000 nuts, a volume of 250 cubic feet is allowed, with a water depth of approximately four feet. The soil and water conditions for the sites of the retting pits are carefully selected since the owners realise that certain conditions produce the right colour and quality of fibre.

The knowledge thus utilised, perhaps empirical, but born of experience, is sound and as will be seen later, is based upon the presence of a suitable admixture of sand and clay in the mud and the amount of water movement in the mud of the river or backwater. The pits are basin-shaped, but in contour may be square or round. The husks are laid in the basin of the pit upon a carpet of coconut or palmyra leaves and the whole mass is covered with further leaves after pressing the husks hard and levelling the top surface. The whole mass is then weighted down to prevent flotation when the water is admitted. The latter is admitted through a small deep channel, and the tidal action should leave the husks, if effectively set in the pit, undisturbed in position. Choudary states that the narrow channel is opened just before high tide, in order to let out the dirty water which has accumulated and is closed once more as soon as the flood of the tide has effected a complete change, so that the pit is filled again with clear water.

(2) In other cases the husks are enclosed in a coir net, which is securely weighted and affixed to four stakes driven into the bed of the backwater, at the corners of a square. This method is frequently used in ponds and rivulets of fresh water not subjected to tidal action.

(3) Soaking is commonly done on the West Coast of India in enclosures, divided off from the lagoons or backwaters. Places where a constant water depth of 4 to 5 feet is maintained are selected,

and stakes of bamboo or poles are driven in as the primary foundation of the boundary of the enclosure. The interspaces are then filled in with coconut leaves or cadgans, whereafter the husks are put into the enclosure so made, covered with leaves, pressed down by the feet, and weighted in position. The poles project 18 inches above water level and are firmly fixed in the mud. This method finds more popular favour than the others mentioned above.

(4) The Bulletin of the Imperial Institute (Vol. X, No. 2, July, 1912) makes the following statement:—"In the preparation of the best commercial coir by modern methods, the husks are retted by being steeped in tanks of water warmed by steam, thus shortening the treatment considerably."

(5) Copeland, in his book gives an insight into modern practice in the Philippines wherein he states that in the best equipped factories the husks are soaked in concrete tanks in fresh water and for only two or three days. They are then removed and subjected to a mechanical decorticating or combing device, which holds them against a revolving cylinder furnished with long sharp teeth in the periphery. The combing is repeated four times or so. After this the fibre is washed by brushing in fresh water until practically clean, then it is sun dried in open yarns or upon concrete courts. The fibre thus obtained is combed again when dry, before sorting.

Investigation of Factors concerned in Retting

Before passing to a discussion of newer chemical methods of retting, etc., let us examine the processes involved in the natural methods outlined above. Two outstanding pieces of research work on these points are available, namely that of Fowler and Marsden, and that of Choudary. The former workers devoted their attention to the microbiological and bacteriological aspects of the process, whilst the latter closely investigated the relative importance and functions of the several factors involved in retting as ordinarily practised. Fowler and Marsden concluded that the process of retting was due to organisms which were derived from the coconut husk direct, irrespective of water conditions, and they elucidated the activity of such organisms fully. Their argument may be quoted as follows:—"If the coconut husk itself carries the bacteria which assist the sproutlet of the seed to force its way through the husk, and these bacteria in the presence of water are able to disintegrate and destroy the matter binding the fibres together, then soaking in water under suitable conditions should permit them to develop their activity

and whether the water is salt or fresh should be immaterial so long as the necessary conditions for maintaining full bacterial activity are assured. The main condition for this would seem to be a controlled temperature and a sufficiently frequent change of water to prevent the killing of the bacteria by any accumulation of toxic life-products". After an exhaustive and logical sequence of experiments, they stated the following opinions :—

(1) That the effective retting of the coconut husk requires only suitable water-conditions. The effective organisms reside in the husk itself, and can exert their full influence in water changing sufficiently frequently to prevent the organisms being poisoned by the products of their action, provided the change is not so violent as to remove too rapidly the accumulating bacteria, etc. That temperature plays a part, and that the influx of cold water retards the retting process by diminishing the activity of the organisms.

(2) That the blue-black colour of the water and the dulling of the fibre are due to its coming into contact with ferruginous water brought down by fresh-water floods from inland, forming tannate of iron with the tannin-matter in process of extraction from the husk.

(3) That the brown colour of the water on first setting to soak is due to the tannin-matter extracted with the juices and that the reddening of the fibre is caused by exposure of the husk to the action of the air, the tannin-matter being highly oxidisable and readily convertible into coloured, insoluble phlobaphenes, similar to the oak-red obtained from the tannin of oak-bark. The growing organisms remove oxygen from the water, and if their activity is checked by fall of temperature, or they are washed away by too rapid a flow of water, the dissolved oxygen in presence of oxidising enzymes suffices to oxidise some of the residual tannin and cause discoloration.

(4) That the cork or pith of the husk is not itself the binding material, but that it is associated with a gum, mucilage or hemicellulose, which is disseminated throughout its cells, is insoluble in water and can be resolved by the action of bacteria or by treatment with water under pressure or by chemical agents. The nature of the tannin-matter however will preclude the possibility of obtaining a coir equal in quality to that obtainable by natural retting unless it can be removed by working under anaerobic conditions.

For producing good coir the conditions near Anjengo appeared to be the best suited, as there the husks are soaked in submerged fields of a fair area, the water being sufficiently shallow for the warming effect of the sun to have full value in accelerating the rate of retting and the narrow openings in the bunds regulating the flow of water and preventing the change being too rapid. No appreciable oxidation of the tannin-matter in the husk can take place therefore and if the openings into the "fields" could be closed at flood time and clean water alone admitted, at high tide say, and any entry of ferruginous water thus prevented, there would be a diminished risk of "blue" fibre being obtained.

As regards shortening of the period required for retting, experiments have shown that it might be feasible to set the husk to soak until the bacterial growth is well established and softening has commenced; then to lift, pass between heavy squeezing rollers and return without delay the squeezed husk to another pit, already prepared. The bacteria could then more rapidly remove the binding matter and since a period of (five weeks sufficed for the complete disintegration of a husk in the laboratory the present requirement of ten or twelve months might be reduced to a period of at least three months.

Now let us turn to the work of Choudary and examine his conclusions.

With regard to the freshness of the husks for soaking his experiments showed that it was far easier to beat soaked fresh green husks than soaked stored husks, i.e. whether soaked in salt or fresh water. In point of time, the stored husks took 1.8 times as long to beat as the fresh husks, showing that the economic factor of labour costs comes into the matter. The colour of the fibre, an important item in assessing its value, from the stored husks is invariably deeper and darker than that from the fresh husks showing that when once the husks are dried, mere water retting alone even under the best conditions, the fibre will be discoloured. It is thus obvious why the current practice postulates that the husks from the freshly harvested green nuts, should not be exposed to storage, etc. for more than 48 hours after removal by splitting. Exposure to sun and weather, results in the husks not soaking properly, the fibre being distinctly more difficult to separate, discoloured and more pithy. The conclusions of Fowler and Marsden would indicate that the nature of the water had little to do with the efficiency of retting, provided that proper conditions of flow and temperature were maintained, etc.

Choudary's work confirms this view largely. He found that there is no difference observed in the ease with which fibres can be separated from husks soaked in fresh, as compared with salt water. The colour of the fibre is very nearly the same. He made one vital observation, however, regarding the relative merits of the two methods, namely, that if the husks are kept in fresh water in ponds for as long a time as they are in salt water they are ruined. The salt in salt water or brackish water prevents over-fermentation without discolouring the fibre, whereas the same is not the case with fresh water. Even with salt water one year seems to be the maximum time of soaking, if loss of colour, strength, and brilliancy are to be avoided. If, however, the husks are removed from fresh water after six months' soaking, the trouble does not arise, neither does it do so if frequent movement of the water, i.e. removal and renewal is maintained. Further experiments upon the addition of salt to fresh water retting tanks, led to the conclusion that "salt does not in any way add to the essential quality of the water for retting." The two main advantages of the salt water method are (a) the constant changing of water due to tidal action and in consequence the continuous removal of deleterious matter which has been created; (b) the time of soaking may be extended to 10 months, thus rendering the process more complete and further, giving greater purity of product with ease of extraction. Where fresh water has to be used it is found that running water is a great advantage, and a shortening of the time of retting by as much as one third is recorded.

Whatever may be the method of soaking, the husks have to be soaked until complete separation is possible and incidentally not for a longer time in fresh water than in salt water. On the West Coast of India the husks are soaked for from six to ten months, and somewhere about the mean of these two figures, i.e. eight months may be taken as about the minimum necessary, under ordinary conditions, to obtain the best coloured fibre. In fresh water soaking, after about seven months, the outer skin gets rotten and cannot easily be removed, therefore the husks should in these cases be removed when they are well soaked after about six months. It has been found that the period of soaking can be shortened by crushing the husks before soaking. A simple crushing machine consists of two heavy rollers, similar to sugar cane crushers, and immediately after splitting the green husks are passed through such an arrangement. If, after soaking husks so crushed for one month, they are removed from the

retting pit and again crushed, upon subsequent restoration to the retting pit the action proceeds more rapidly, the period of soaking being appreciably shortened even reducing the time to as little as three months. To sum up, therefore, it would seem that the time of retting could be reduced, if the economic factors involved made it worth while, and secondly, thanks to the workers mentioned above, a much more complete understanding of current practice is now extant.

Extraction of the Coir from the Retted Husk

Before treating the subject of chemical retting, it would be well to note the methods used for extraction of the fibre after the retted husk is recovered from the pit. When the husk is sufficiently soft it is removed from the pit and any adhering mud or slime is removed by washing in fresh water, the outer skin being peeled off with the hand by squeezing. The husks are then placed upon wooden blocks and beaten with wooden mallets to separate the soft inner fibre from the cork and pith, the latter being eliminated by the beating and shaking. The fibres, still wet, are next spread out in the shade to dry, and when this is attained they are threshed with smooth bamboos about 6 or 8 feet long, thus accomplishing a two-fold purpose of freeing the fibre from entanglement and from residual pith or dust. Smooth and soft fibres should result from the treatment. The fibre, after extraction should not remain wet for more than 24 hours and should be dried in the shade. Drying in the full sun is reputed to render the fibre more difficult to spin, even after re-wetting. As thus obtained the material is now ready for willowing. A hand driven willowing machine is used, which consists of a cylindrical drum in the axis of which revolves a wooden shaft carrying a number of teathed blades set spirally and radially on its axis, which pass through similar teeth fixed to the inner part of the machine at the top and bottom. The pith and cork are thus removed leaving the clean and soft fibre ready for sorting and subsequent processing. Two persons can thus willow some 300 lb. of fibre in eight hours. There are variations of the willowing process but in all cases the object is to secure clean fibre free from pith, dust or cork, and ready for subsequent use.

It will be convenient at this stage to leave the description of these uses until a consideration of other methods of retting has been accomplished.

Chemical and Mechanical Methods for quick Retting of the Husks

It is generally recognised, that provided the raw material from which the start of a process is made, is of the same type and quality, great uniformity of final product can be obtained by carefully controlled and manipulated chemical treatment. It would seem a *sine qua non* that previous to chemical treatment the husk should be split or crushed as much as possible, a factor which may not be economic except upon a fairly big scale. In the study of such processes one may perhaps concentrate upon a discussion of some three or four methods of more recent origin, and different in principle. As to crushing there are already machines on the market for this purpose, but special apparatus is provided to render the husk in the most suitable form for specific treatment in two of the methods described below.

Apart from this, one machine exists wherein the husks, fresh from the opening, are passed through heavy rollers into which they are fed mechanically and continuously through a hopper from above. One of the rollers is so arranged that it is capable of movement sliding backwards and forwards to meet the requisite variability in husk size. Although only occupying a floor space of 5 sq. ft., it is claimed that such a machine could deal with 8,000 husks per day, i.e. the total yearly crop from $2\frac{1}{2}$ acres of plantation, approximately, thus requiring a large area and further, good transport facilities. The husks, crushed in one way or another, are then ready for one of the retting processes, the details of which may now be described.

(1) *The Nanji Process*.—An Indian scientist, Dr. D. R. Nanji, working in the University of Birmingham, studied the question of retting and separation of various vegetable fibres, one of which was coir. Owing to the low economic price level prevailing in the coir industry, his process has not yet found commercial application, and even so, still needs careful investigation before adoption. The process briefly consists in the treatment of partially crushed green or dry husks with a mixture of lime or sodium sulphate or sodium carbonate containing a trace of aluminium sulphate at steam pressures of 80–100 lb. per square inch, for a period of 1–2 hours. On such treatment the inter-cellular pithy substance gets completely loosened from the fibre proper. It is then removable by washing off the digestion liquor and the remnant drops off completely in willowing or opening after subsequent drying. It is claimed that the strength of the fibre is not affected by the treatment although the colour is

darker than that of commercial coir. The fibre so obtained is, in general, finer than that obtained by ordinary retting, and the best results are obtained with green husks freshly opened, although dried husks are quickly responsive to the treatment.

(2) *Elod and Thomas Process*.—A similar method is apparently covered by Elod and Thomas in a U.S.A. patent taken out in November, 1931. They state that the material is immersed for a short time in hot water, pressed, immersed again for a short time in hot water, after which the embedded fibres are separated from the cork and pith by mechanical treatment. During the second hot water treatment, substances of "the slaked lime type" are added to the water and discoloration is thus avoided.

(3) *Rowell Process*.—A further method on similar lines is described by C. V. Rowell in E.P. 338,561, in 1932. The mesocarp and shell of coconuts may be decorticated by being subjected in a compacted condition, in a closed chamber, to steam gradually raised to 550–900 lb. per square inch, the temperature being substantially equalised throughout the mass from 8–50 seconds, and the material extruded under steam pressure through one or more constructed orifices.

This process is claimed to be more economical and effective than retting in warm water or steeping in alkali solutions, followed by cutting or crushing. The fibres come out loose from the steaming chambers, the waste as mud and liquid. The whole fibre mass is then washed, after which the fibre is ready for drying into a condition for manufacture.

The pressure is varied for different fibres ; for instance, for coconut husk and hard dry stock it is from 800–900 lb. per square inch. This process is claimed to be applicable to mature nuts.

(4) *The Van der Jagt Process*.—It is claimed that by this method it is possible to extract the fibre in marketable form from fully matured nuts in less than two hours by chemical and mechanical means. The method also covers the subsequent spinning and weaving, and since matured nuts can be used it is stated that copra can be produced in the same factory, utilising the waste, the shell and coir dust in suction gas generators, to provide heat and power to drive the machines and dry the products. There is no doubt that such co-ordination of all branches of the industry would be most economical but it remains to be seen whether the methods now proposed could accomplish this. A full description of the Van der Jagt process has appeared in the "Engineer" for June, 1912, and can be consulted for details.

The raw husks are fed on to a conveyer and opened in a husk preparing machine. A second conveyer takes the opened husks to the boiler in which revolves an endless chain, equipped with paddles, carrying the husks round with it in a weak solution of caustic soda, raised to the boiling point. After boiling for the requisite time, adjustable by the speed of the endless chain, the soft weak husks are conveyed to a machine which not only opens but squeezes them thoroughly. The opening is performed by pinned bars fitted on chains moving at different speeds and finally the excess caustic soda solution is expressed from the fibre by means of fluted rollers. It is stated that the liquor thus recovered can be used again for boiling fresh charges, in fact the caustic soda seems to be only utilised to start the operations. Thus the process is really more mechanical than chemical. A picker card, specially constructed to work fibre more than 100 per cent. wet, re-opens the compressed fibre, and discharges it on to a conveyer which delivers it to a softener and cleaning machines which equipped with six pairs of fluted rollers, removes the last remnant of coir dust from the fibre. The material passes from the fluted rollers immediately on to a series of six pinned rollers, which after opening it out once more, cause separation of the coir dust ; the action of cleansing and dust elimination being continued in the machine, where the fibre passes through four sections each of four rollers.

The fibre is now dried mechanically and softened for the spinning process which is to follow. The latter process is accomplished in an ordinary jute softener. The coir fibre so obtained is adapted for carding and thence forward, the process is carried out on machinery similar to jute machinery, with modifications to meet the special characteristics of the fibre. At the delivery end of the breaker card, there is an arrangement for subjecting the sliver to heavy pressure in order to keep it together. The sliver is collected in four reels, side by side on the same shaft and is then fed into a finisher card.

From this stage a set of drawing frames of the ordinary jute type are employed and at the conclusion of this process the material is spun on a self-regulating gill spinner of the ordinary type, suitably modified. It is claimed that coir fibre can be thus spun into one lea yarn or 48 lb. yarn.

The cost of a complete unit, inclusive of buildings and bungalows for employees, for working five million coconuts per annum is given as £40,000. Coir so produced has been woven into sacking for transport of manures, etc., and is certainly softer than the ordinary type

of coir produced normally. It is, however, considerably darker in colour than the best fibre produced ordinarily. This process is one for which full patent rights have been acquired. It would seem, however, that such a softening process would render the fibre unsuitable for many of its ordinary uses, and yet for cordage purposes and textile uses in new spheres of utility, it would undoubtedly have to meet the competition of other fibres of similar character. The economic consequences are therefore undetermined.

(5) *The "H.G." Process, with ionised oil.*—This process, developed by E. V. Hayes-Gratze of London, is the subject of a series of patents, and is distinct from any other in regard to the method and the material used. It is adaptable to either factory or co-operative village conditions.

Taking full cognisance of the existing methods for extraction of coir, it is proposed in the following short resume, to divide the description of the Hayes-Gratze process into three sections so that its alternative applications to existing methods and conditions may be understood, namely:—

- (1) General outline of the process with mechanical and fluid treatment.
- (2) The treatment and softening of coir fibre already extracted and available.
- (3) Adaptability to the widespread extraction by native labour and methods.

For bulk production at a central factory the process would embody:—

- (a) The handling and treatment of the whole nut and husk.
- (b) The handling and processing of the husks alone.

In the former case (a) the nut can be extracted and husk removed in one operation, effected by a single machine, the useless "core" or top where the stem had been connected being cut away and the husk (fleshy pith and fibre) sliced into sectional layers running lengthwise with the grain of the fibre therein.

The husk is therefore ready for retting treatment and the nuts for cracking and extracting of the kernel for copra, etc.

The husk contains a considerable percentage of moisture and coloured matters, etc., and as these are apt to stain the fibre during treatment, the sections are compressed or rolled to exclude excess of these substances, after which they are passed continuously through one or more washes of water (preferably hot) and then rolled again.

The next operation subjects the husk sections to immersion in a solution of water and ionised water-soluble H.G. oil, having a pH value of not less than 7, the solution being maintained for preference at boiling point, or not less than 200° F. The period of immersion depends on the freshness of the husk and will vary from 1-4 hours during which time the mass of saturated pith and fibre is kept in constant movement and subjected to intermittent mechanical pressing and rubbing action by a special machine combining the tank and pressure jets, etc.

This machine ensures removal of the bulk of the fleshy and other extraneous matter through suitable grids and frames by allowing it to sink to the bottom where its removal is facilitated. The extracted fibre piles up at one end and may be removed at periods or continuously.

The ionised oil not only facilitates the splitting up and separation of the fibre and adhering matter, but has the effect of being absorbed by the former. The fibre is thus softened to an extent which enables it to be spun and woven on machinery of the jute type, eliminating the necessity of "flattening" the filaments, thus leaving them with their natural sectional structure. It is claimed moreover that the colour is lighter and elasticity improved without impairing their natural strength.

After removal from the ionised oil machine the fibre is pressed or rolled to exclude the excess of liquor; the fleshy matter or pith being treated in the same manner and the liquor returned and used again. By this means very little oil is wasted and that remaining on the fibre facilitates the subsequent operations of brushing, combing, carding and spinning, etc. It may easily be made into a sliver, impregnated or dyed, moreover it is absolutely immune from bacterial attack and enables the worked yarn or fabric to be self-scoured.

An even greater flexibility and softness may be imparted to the fibres by washing them after they have been pressed or rolled (following the oil treatment) if they are then dried and again immersed in a second solution of ionised oil and water, squeezed again and finally dried.

No appreciable loss of oil or liquor (beyond the small percentage absorbed by the fibre) should occur during these operations and the excluded fluid is returned to the tanks.

The ionised oils undoubtedly have a bleaching effect as well as being easily emulsified.

It may be noted that the splitting of the husk into sections enables the division or separation of the coarse and finer fibres to be attained more easily.

The fibre may be carded and spun immediately after the squeezing following the oil process, providing machinery for this purpose is available.

(b) Alternatively, if the split husks, i.e. those husked on the field, are received at the factory for treatment, these are sliced into sections by a special cutting machine, immersed in water, and then compressed or rolled, thus enabling the bulk of extraneous juices to be removed, after which the procedure is exactly the same as already detailed.

Quite apart from the large amount of coir fibre already extracted and in existence, the supply is bound to continue to come from existing methods of extraction and sources. This fibre is unsuitable for fine spinning or making into thinner fabrics, and the fact that it may be softened by the ionised oils at low cost might be useful.

The procedure is described as follows :—

The fibre is first immersed in hot (or preferably boiling) water for 30 minutes to 1 hour, then pressed or rolled to exclude as much moisture as possible. After drying it is placed in a tank containing the H.G. ionised oil and water solution and boiled for about 1 hour, the immersion period depending on the quality and fineness of the fibre. The solution is then excluded, the fibre dried and is ready for the following processing as previously detailed.

With regard to the uses of the oil for local extraction by native labour, the method should reduce the time for retting from months to hours. Assuming financial and other problems preclude installation of large plant, it may be advisable to form small co-operative "centres" where the husks can be treated. This would enable the operations for cutting or sectioning the husks, mechanical action during immersion in the ionised oil solution and rolling or pressing, to be carried out in semi-bulk fashion. On the other hand, individual or small growers can instal a tank to contain the oil solution, heat this from a fire made with shell or waste and immerse the broken husks for several hours, agitating occasionally. The loosened fibre and fleshy matter or pith must then be pressed or drained after which the fibre is cleaned and washed by the usual methods as performed after water retting. The consumption of oil will naturally be higher but further saving could possibly be effected by allowing the husks to dry partly (failing facilities for squeezing) and then steeping them first in a tank containing "used" oil solution.

The provision of suitable tanks should not present any great difficulty as these may be, if necessary, made of concrete, etc. at low cost. It is claimed that any extra cost, if such ensued, would be more than compensated by the saving of time, higher yield and better fibre, quite apart from doing away with the pollution of water and other unpleasant effects of existing procedure.

Claims regarding the process are to a large extent being vindicated. It must be remembered, however, that full scale experiments on a manufacturing basis have not yet been completed ; on the other hand, samples submitted in sufficient quantity to be treated on ordinary jute machinery have been successfully carded into a sliver and spun with little modification of the ordinary jute process. The colour of the fibre so produced left little to be desired and it was demonstrated that by further treatment the fibre could be almost bleached to a pale straw colour, although in so doing, there was a slight loss of strength. In any case, the process is now being developed and large scale plant is already designed and installed in London, and in view of the new uses for the fibre resulting therefrom, it is worthy of careful consideration and investigation.

Before passing on to the discussion of subsequent treatment of the coir, there are two aspects that seem to call for investigation. Although the question of salinity of the retting liquor has been closely observed, yet the question of alkalinity, or in general, the pH value of such liquors has been apparently largely disregarded.

That such is of importance is indicated by the bacterial action which is stimulated upon ordinary pit retted coir fibre in contrast to the chemically and mechanically separated material. Retting with a view to subsequent dyeing or even with a view to subsequent utilisation, may become a possibility when conditions, etc. are more definitely controllable.

Sorting the Fibre

Before utilisation, the coir has to be sorted into the various market gradings. The fibre has to be subjected to a process of combing or hackling with a view to ready separation into sorts of different lengths and qualities. Roughly, a threefold commercial classification is made.

(1) "*Mat Fibre.*"—This is of the finest quality and is spun into yarns for the manufacture of ropes, twines and matting.

(2) "*Bristle Fibre.*"—A coarser and thicker quality employed in the manufacture of brushes and brooms.

(3) "*Curled Fibre.*"—A short variety, used for mattresses or for stuffing upholstery as a substitute for horse hair, etc.

Any dust or refuse resulting from such separation may be used locally as a manure or as fuel.

It has been suggested that the opening of the husk and sorting of the fibre could be mechanised. A method has been put forward by a British firm of machine makers and briefly may be described as follows :—

After the retting is complete, by any method, the husk is quickly passed through a crusher, and the crushed and retted husks are conveyed directly into an opening machine. Here they are seized by a pair of fluted rollers which carry the husks through to a cylinder and hold them whilst a serrated or toothed drum extracts the fibre and so shreds the whole husk up completely. In the extraction of the fibre, facilities can be provided for the separation of fibres of various degrees of fineness. The first treatment would subject the husk to the action of a steel drum, round the periphery of which are fixed steel teeth. The teeth attack the husk and tear away the fibres. If the process is only partially completed on this machine and the husk then subjected to a similar treatment on a drum clothed with finer teeth, the second product naturally completed the extraction of all the fibre except that next the skin or outer layer. The outer layer consists of long, harsh, strong fibres known as "bristles" or "brush" fibre. This needs special treatment. The bristle fibre is passed into steel combs several times, and finally, after being freed from all extraneous matter, is dried, sorted in sizes, and made up in bundles ready for the brush makers.

The above processes separate the classes of the fibre mechanically and keep distinct the separate qualities of the fibre. Of course, if this separation is not required the whole extraction can be done in one treatment. The fibre and the separated dirt and former adhering matter now fall together and are transferred to a willowing machine. This consists essentially of a gauze cage capable of rotation, attached to the axis of which are rapidly rotating steel beaters, carried spirally. The cage rotates slowly and the beaters rapidly, thus ensuring thorough willowing and cleansing. The waste matter, dust, dirt, short bits of fibre, etc., are thrown out through the interstices of the mesh of the cage and the fibre remains to be gradually withdrawn as the process is completed. By tilting the cage, the length of time of operation of the treatment can be controlled at will. The fibre is now ready for drying, either normally or by artificial heating methods.

There seems to be a point here for investigation. Can quick artificial drying yield the same fibre characteristics as ordinary methods? A partial bleaching action would seem to go on simultaneously with drying and one is tempted to wonder whether some form of irradiation during the process would ensure a better product.

The speed of such a process as outlined above is obvious. On the other hand, Choudary and others have shown that removal of the husk from the pit and mechanical crushing during the time of ordinary retting greatly reduces the period necessary. This is the principle of the Van der Jagt and in part of the H.G. systems.

Mechanical action is maintained during the whole time of treatment continuously, so that the question of mechanical opening does not arise directly in their processes.

Sorting, however, is important, and no doubt both manual and machine methods could be profitably employed. The whole point would seem to become economic and if insufficient quantities are available for machine treatment without undue transport charges, then probably hand methods would prevail for sorting. Local conditions of production and marketing have to be considered in this regard. Nevertheless, just as in India the jute industry has progressed towards industrialisation in factories, and the cotton spinning and weaving industry has moved similarly, it may be that the future of the coir industry, in conjunction with the copra and coconut oil industry, will traverse a similar path. In any case, the latter has already done so to a large extent, the power-driven driers and oil presses quickly replacing the older methods.

It may be argued that such developments would have a profound effect upon the economic life of the country in the coir producing districts. History shows that wherever progress is made from manual to power production, from the cottage industry to the factory, economic life is altered for a large number of people. On the other hand, history shows, as exemplified in the jute industries, that such transition inevitably results in larger production and a great increase in the number of the personnel employed. Such economic dislocations are therefore to a large extent only temporary. In the ionised oil process, use can be made of coconut oil, ionised and suitably treated, and on this account it is worthy of close investigation.

Utilisation of the Residues from Fibre Extraction

It has been estimated that in point of weight the yield per nut of the pithy and cork-like matter constitutes as much as 70 per cent.

of the husk. At present this is a waste product, which is largely irrecoverable. The mechanical and chemical retting methods suggested above make this portion of the nut definitely recoverable. Van der Jagt suggests its use as a source of gas or for combustion to supply heat and power, along with the shell, etc. Hayes-Gratze suggests that it is recoverable as a fine dust for which a variety of uses could be found—amongst others he mentions its possibility as a substitute for cork dust.

On the other hand, as Sampson has pointed out, in most countries coconuts are generally husked in the field and these are often spread on the ground to form a mulch as well as to assist in the maintenance of the fertility of the soil. Thus the idea of rendering the waste residues, which are highly carboniferous and contain a fair proportion of nitrogen, into manure may be examined. The scarcity of manure for purposes of tropical agriculture is often a serious matter in the production and development of various forms of cultivation. The creation of manure from waste products on the spot, with only minor transport costs, is worthy of consideration.

Sampson quotes comparative figures regarding the amounts of nitrogen, potash and phosphoric acid present in coir dust and cattle manure. His figures are appended below:—

				<i>Cattle Manure. lb. per ton.</i>	<i>Coir Dust. lb. per ton.</i>
Nitrogen	..	..	..	21.73	9.75
Phosphoric acid	..	..	..	10.66	1.54
Potash	..	..	..	4.00	2.24

The analyses of the fresh and the retted husk suggest that there is not an excessive loss of fertiliser ingredients in the process of retting, except in the case of potash.

<i>Calculated on Dry Weight.</i>				<i>Fresh Husk. Per cent.</i>	<i>Retted Husk. Per cent.</i>
Nitrogen	..	..	..	0.53	0.74
Ash	..	..	..	6.71	8.07
containing					
Phosphoric acid	..	..	..	0.111	0.076
Potash	..	..	..	2.65	0.15

These figures for comparison of coir dust and cattle manure are taken allowing the same amount of moisture in each (50 per cent.), and the latter refers to stall-fed bullocks in the tropics. It is evident that in this form, as taken from pit retted husk, the value is considerably less than cattle manure, but on the other hand, there may be, as a result of research, a method—bacterial or otherwise—as is known for other carbonaceous materials, of rendering the final product more valuable in this direction. Alternatively, it is probable that the dust will prove to be most economically used as fuel in the process, especially where copra drying is done continuously and would supplement the supply of shell for this purpose.

Experiments are also being conducted to explore the possibilities of utilisation of coir in the form of short fibres, say less than one-eighth of an inch in length, as a reinforcing medium and consolidation basis when admixed with plastics, such as rubber, cement, plaster, etc.

In the former case attempts are being made to produce material to withstand abrasion such as might be experienced by leather, etc., and in the latter to evolve a medium suitable for casts, moulds, etc. which may be subjected to the rigours of weathering on the outside of buildings or for decorative ceilings, etc.

The highly polished surface of the coir, however, militates against good adhesion in ordinary plasters, but combined with ionised oil and rubber latex, a compound is obtained which has distinctly promising characteristics as an imitation leather.

The coir dust which has proved most efficacious for admixture with pitch or bitumen consists of 6–7 parts by weight of coir waste or short ground fibre up to $\frac{1}{8}$ in. in length together with 3–4 parts of granular coir pith or waste fleshy matter, recovered after the retting process by beating or in the waste liquors of the ionised oil method, of the right size of grain to mix correctly in the plastic mass. Such plastic mixtures have been applied successfully to pipe and cable coverings with excellent results as a protective medium.

Properties of the Fibre

Before turning to a discussion of subsequent manufacturing processes and uses, it may be well to review the existing scientific data relative to the fibre. It is extraordinary how little is known and how little has been done to investigate the fibre as a chemical or physical material and to study its possibilities of exploitation in

new directions, having regard to its peculiar characteristics, or the possibility of modification of the same, thus rendering it suitable for utilisation in new spheres of industry.

Kirk (Textile Manufacturer, March 15th 1931) states that Claviez working in Saxony, gives the fibre as being tubular in section and by freezing he was able to reduce the material to its ultimate fibres, finding that such were one two-hundredth of a millimetre (0.005 mm.) in diameter. Copeland quotes a table taken from Lecomte's "Textile Vegetaux" which gives the data for the size of ultimate cells of the various textile fibres of commerce and shows that the ultimate individual coir cells are the shortest of all commercial fibres extracted from plants having an approximate length of 0.7 cm, and an average diameter of 20 microns.

The long strands, which are more commonly referred to as the coconut fibres, have a length of 30 cms. or so, depending on the nut from which they are extracted whilst the diameter is somewhere about 0.3 cm. Copeland states that the cross-section of the fibre is roundish and somewhat heart-shaped, "the concavity or groove along one side being the place where the vessels were located. The fibre is strongly lignified and to this is due its colour and harshness and its relative brittleness as compared with pure cellulose fibres."

Heerman and Herzog give the average length of the ultimate coir fibril as 1 mm. and its mean breadth as 16-18 μ . Of the total area of cross-section (given as an average of 168 sq. μ) 76.8 per cent. is cell wall and 23.2 per cent. lumen. They give the metric number of the fibre as 4717. The fibre is described as being of reddish brown colour, the cross-section being fasciculate and polygonal. The fibre is highly lignified. The lumen is round and somewhat narrow. The end of the fibre is blunt and stumpy, whilst a microscopic investigation shows that the pores in the fibre are small and oval. In the ash the chief constituent is composed of siliceous particles of yeast-like appearance, grouped together. Matthews in his book on "Textile Fibres" gives the average fibre length as about 10 inches and consists of a smooth, stiff, elastic filament which possesses remarkable tenacity and curls easily. He gives the fibre elements as being from 0.4-1 mm. in length and 12-24 microns in diameter, the average ratio of length to thickness being 35. The cell wall is thick, although irregularly so, and the lumen consequently has an irregularly indented outline. Pore canals penetrate the cell wall. The surface of the fibre bundles is occasionally covered with small lens-shaped silicified stigmata, about 15 microns in breadth. Matthews states that "These stigmata fuse together on ignition, giving a blister on the ash".

Microchemical Reactions

Matthews quotes a table showing that coir gives the following microchemical reactions :—

<i>Reagent</i>	<i>Result of Action</i>
Iodine and sulphuric acid	Golden yellow coloration.
Aniline sulphate	Intense yellow coloration.
Schweitzer's reagent	No action.
Neocarmine W.	Olive brown coloration.

Matthews gives the shape of the fibre as oval and quotes its superiority to all other fibres in its resistance to water, mechanical wear, combined with its lightness and elasticity.

Elasticity

Mark has recently suggested that the bundles of long molecular chains of which the ultimate fibrils of coir are built, known as "micelles", are originally orientated almost at random in the fibre and on stretching gradually turn to assume a direction parallel to that of the stretching force. He proposed a formula connecting tensile strength with the dimensions of the various attributes of the fibre, namely

$$F = F_0 \frac{v^3}{1 - \rho + \rho v^3}$$

where v is the extension of the fibre as given by the equation $v = l/l_0$, l_0 being the initial length and l the actual stretched length of the sample, ρ represents the axis ratio of breadth to the length (i.e. $b/l = \rho$) of the geometrical dimensions of the micelles, and F represents the strength of the fibre.

Van Iterson has shown that if fibres are classified by the method due to Sonntag, into ductile and non-ductile varieties, the extension curve of the non-ductile fibres (flax, ramie, hemp, etc.) has the form corresponding to $l = 10b$ in Mark's equation, whilst for ductile fibres, such as coconut extension curves corresponding to $l = 3b$ in Mark's equation are obtained. He concludes that in the unstretched fibres of the non-ductile variety the micelles are orientated almost parallel to the direction of stretching whilst in the ductile class under the same conditions they are orientated obliquely in regard to the fibre axis. The first kind of fibres only allow a small extension and the latter a large one, thus producing a larger range of the extension curve.

The important characteristic of ductility of coir or its ability to stretch beyond its elastic limit without rupture, as well as its power to take up a permanent stretch when so loaded, is of the greatest commercial consequence. Sonntag has shown that ductile fibres are generally highly lignified, but the degree of lignification and the ductility are apparently not directly related, many highly lignified fibres being non-ductile. Sonntag connects the ductility with the physical structure of the cell wall. It has often been noted that striations appear on the lamellae of cell walls. These markings usually form a right-hand spiral on the outer or primary membrane and a left-hand spiral on the inner or secondary membrane, and are generally regarded as indicative of the molecular structure of the cell walls. Sonntag looked for the explanation of ductibility in the arrangement of these spirals. By maceration he isolated the cells and measured the angles made by the striations with the longitudinal axis of the cell. The angle of the micellar planes is often indicated in the pores which follow the line of cleavage. By microchemical methods Sonntag measured the angles between the striations or pores in each membrane and the axis of the cell. His results for a ductile fibre (coir) and a non-ductile fibre (*Cannabis sativa*) are shown below:—

Fibre.	Condition.	Inclination of striations in the		Extensibility of Fibre.
		Primary Membrane.	Secondary Membrane.	
Coir	Air dry	53°—54°	30°—53°	Up to 16·0%
<i>Cannabis sativa</i>	Air dry	90°	4°—8°	Up to 1·27%

These figures clearly show that the striations of the non-ductile fibre in the outer lamella are nearly perpendicular to the cell axis, whilst those of the inner lamella run more nearly parallel to it. In the ductile fibres the striations are obliquely orientated to the cell axis.

Polarised Light

The examination of ductile fibres by means of polarised light shows that variations in the polarisation colours follows very closely the variations in the figures for the angles of inclination of the striations, ductile fibres forming a distinct group. The early discovery of the

significance of double refraction of light by fibrous cellulose structures and its subsequent verification by X-ray analysis is well known. There results from such measurements, therefore, two values of the refractive index for light corresponding to the deviation of the ordinary and extraordinary rays in their passage through the fibre. The difference between these two values of the refractive indices is indicative of the internal structure of the fibre material. Thus with the assistance of what are known as addition or subtraction methods of analyses by polarised light, the position of the optical index ellipse of a fibre may be determined. Heerman and Herzog have shown that most technically employed fibres are optically positive in relation to the axis of their length, i.e. the long or major axis of the index ellipse runs parallel to the longitudinal axis of the fibre. In this regard, however, coconut fibre presents an interesting exception to the rule, in that different from other technical fibres of commerce, it is optically negative. This affords a means of identification and differentiation from other fibres. Thus, from arguments derived from its molecular structure, we should expect to find coir highly extensible and elastic.

With regard to elasticity, Choudary states that a coir fibre will extend by fully 25 per cent. of its original length before rupture, whilst Copeland confirms this figure. He remarks that ropes made of coir will stretch more than ropes made of any other commercial fibres of a similar nature. This property makes coir ropes singularly efficacious where intermittent or jerky strains are concerned.

Coir has another great advantage in that it is more durable than most other fibres, particularly where water exposure is concerned, that is, it is less subject to decay. Its tensile strength and its resistance to decay are illustrated by Copeland in the following table :—

Name of Fibre.	Breaking strength when fresh.	Breaking strength after 116 days in water.
	kg.	kg.
Arenga saccharifera	43	42
Coir	39	24
Jute	30—31	18—21
Sansevieria zeylanica	54	13
Crotalaria juncea	31	decayed
English Hemp	47	"
Calcutta Hemp	34	"
Agava americana	50	"

Copeland concludes :—" Of the fibres represented in this table, then the most resistant to decay is Arenga (the sugar palm, Cabo, Negro), and after it, coir. Arenga is the best of them where it can be obtained, and is accordingly first choice in all such places, but it is not an article of general commerce."

Besides its resistance to decay as indicated above, it has unique powers of resistance to microbiological attack. Eight samples of coir were examined in this regard, three of which, Nos. 1, 2 and 3, were ordinary Cochin fibre retted and separated by ordinary methods, whilst the others were selected as follows :—Nos. 4, 5 and 6 were produced by chemical retting from nuts sent over by the Director of Agriculture, Madras, whilst No. 7 was a further product from Madras nuts, treated slightly differently. No. 8 was a sample of fibre, retted in India which had been subjected to a special softening process in England as an experiment to see if such was possible, without seriously detracting from the resistant properties of the fibre. Two sets of experiments were performed, the modus operandi being described below.

One gramme portions of the material were placed together with 100 cc. of a filtered suspension of soil in tap water (pH 7·05) in flasks and incubated at 23°C. The contents of the flasks were examined after periods of seven and nineteen days with the following results :—

Description of sample.	Observations.	
	After 7 days.	After 19 days (Microscopical examination).
No. 1. Dull yellow	Abundant growth of mould fungi.	Much fungal growth and a slight degree of fraying of the fibre edges. Bacteria were absent. Liquid acid.
No. 2. White to pale yellow.	Abundant growth of mould fungi.	The material was distinctly weak, the fibres disintegrating into their component elements. Fungus mycelium prominent but bacteria absent. Liquid acid.
No. 3. Brownish yellow.	Abundant mould growth.	Fibres showing slight fraying along their margins. Mould mycelium abundant. No bacteria present. Liquid distinctly acid.
No. 4. Light reddish brown.	No obvious change or evidence of growth.	Coir appeared to be in good condition. Bacteria active but mould fungi less conspicuous. No disintegration of fibres. Liquid neutral to bromo thymol blue.

Description of sample.	Observations.	
	After 7 days.	After 19 days (Microscopical examination).
No. 5. Brown ..	No evidence of microbial growth.	Bacterial growth taking place but no evidence of fibre disintegration. Liquid alkaline.
No. 6. Pale brown	No apparent change except for a brown discolouration of the liquid.	Bacteria abundant. Moulds present but less common. No evidence of fibre damage. Liquid slightly alkaline.
No. 7. Reddish brown.	No apparent change except that liquid is slightly coloured.	Bacteria present but no positive signs of fibre disintegration. Liquid slightly alkaline.
No. 8. Light brown	No apparent change except for discoloration of liquid.	Bacteria active but no fibre disintegration. Liquid slightly alkaline.

As far as the experiment progressed it appeared that all the samples of coir exhibited a very considerable resistance to attack by micro-organisms. The first three samples weakened slightly, No. 2 being in the worst condition after nineteen days. It is of interest that these materials had most probably been attacked by mould fungi only and not by bacteria, which are unable to thrive under acid conditions.

The five other samples remain unaffected after 19 days' incubation in spite of the presence of large numbers of bacteria. The neutral or slightly alkaline condition of the liquids appears to favour these organisms rather than the mould fungi.

The second experiment was carried out in a medium designed to facilitate the growth of micro-organisms. The composition of this medium was as follows :—Dipotassium hydrogen phosphates, 0·1 per cent. ; magnesium sulphate, 0·1 per cent. ; sodium chloride, 0·1 per cent. ; peptone, 0·2 per cent. ; calcium carbonate, 2·0 per cent. ; the ingredients being added to tap water. The presence of excess calcium carbonate ensured a slightly alkaline reaction which in the case of the acidified samples Nos. 1, 2 and 3 was of importance since it enabled bacteria to develop. The liquids in the second test were inoculated with soil water and incubated at 23° C. The observations made were as follows :—

Description of Sample	Expt. 1. Contd. from Previous Table.	Expt. 2 (Special Medium).	
	After 87 days.	After 30 days.	After 61 days.
No. 1. Dull yellow.	Slight increase in tendering. Material not appreciably weakened. Abundant fungus growth.	Slight evidence of tendering. Fibres fraying at the edges and easily split by treatment with dissecting needles.	No appreciable increase in tendering. Material soft and fairly easily torn apart. Mould fungus action slight.
No. 2. White to pale yellow.	Tendering slightly advanced. Bulk of fibres still intact but material definitely weakened. Mould fungi abundant.	Material badly tendered, fibres being split up into their constituent elements (fibrillae). This sample was more damaged than any other of the series on this date.	Material reduced to a mush. Abundant disintegration into individual fibrillae. Mould fungus negligible.
No. 3. Brownish yellow.	Material definitely weakened, more so than sample No. 1, much less than sample No. 2. Fibres easily dissected into their component elements. Mould abundant.	Definite tendering of the fibres, many having disintegrated. The remainder break up easily on teasing out with dissecting needles.	Tendering slightly advanced. Material definitely weak. Abundant detached fibrillae but fibres not reduced to the mush condition. Fungi not conspicuous.
No. 4. Light reddish.	No definite evidence of tendering. Fibres still coarse and strong.	No definite evidence of disintegration. Fibres very slightly frayed locally at the edges.	No change in condition. Mould fungi not observed.
No. 5. Brown	Tendering definite but slight. Less than sample No. 1 and 3 (in envelope) Material soft. Fibres dissected into component elements fairly easily. Mould fungi conspicuous.	Fibres slightly softer but do not appear to have undergone much disintegration.	Tendering at most only very slight. No mould growth observed.

Description of Sample	Expt. 1. Contd. from Previous Table.	Expt. 2 (Special Medium).	
	After 87 days.	After 30 days.	After 61 days.
No. 6. Pale brown.	Material not perceptibly weak. Slight superficial tendering. Fungus growth abundant.	Material softer than original but amount of tendering slight.	No appreciable change. Material may have been slightly tendered.
No. 7. Reddish brown.	As for No. 1 (loose)	Fibres have undergone at most only very slight tendering. No splitting up observed.	No change in condition. Mould present but scanty.
No. 8. Light brown.	Fibres show evidence of slight superficial tendering but they are neither split nor perceptibly weak. Mould growth very abundant.	Material slightly softer perhaps but shows no definite evidence of disintegration. Fungus growth at surface liquid very pronounced.	Fibres in bottom half of liquid show no perceptible change. Those near surface are definitely tender although not begun to disintegrate. In all probability specific fungus growth at surface was responsible for this condition.

It will be observed that the prolonged exposure of the first series of coir samples to microbiological action failed to bring about their complete disintegration. One sample only, viz. No. 2, was seriously damaged.

With regard to the second experiment, bacteria grew abundantly in all the liquids due to the stimulating influence of the peptone and the alkaline reaction. In spite of this, four of the samples, viz., Nos. 4, 5, 6 and 7, suffered little damage. Of the remaining four samples No. 2 was almost disintegrated, No. 3 fairly badly damaged, and No. 1 slightly damaged as the result of bacterial action. Sample No. 8 suffered severe local damage due to the action of a specific mould fungus in the presence of air. It is probable that in the

absence of this fungus, little tendering would have taken place. A control in which sample No. 2 was exposed to the action of tap water in which microbiological action was suppressed by the addition of thymol, failed to show signs of deterioration after 31 days' incubation.

In conclusion, therefore, it would appear that, with the exception of sample No. 2, which was susceptible particularly when subjected to alkaline conditions, all the samples of coir are very resistant to micro-biological action. Samples Nos. 3 and 1 appeared to be next in order of susceptibility.

A further and more rigorous test was made independently to determine the bacteriological susceptibility of coir, by according it a test equivalent to attack by bacteria if the material was buried in damp earth for a protracted period. With ordinary retted Cochin or India coir, after 194 days' immersion the cellulose content had dropped from 65.2 per cent. to 45.7 per cent. When chemically retted coir was used on the same test the figures before and after 134 days' immersion were 57 per cent. and 56.6 per cent. respectively. This deterioration is much less than that of any other previously tested, showing the superiority of coir in this regard, and especially of the chemically treated samples.

It would seem, therefore, that coir from chemical and mechanical retting processes as outlined above, is more resistant to bacterial attack than that produced under ordinary conditions. This may be due to the more complete separation of the pith and dust, thus leaving no matter on the fibre likely to decay further under the action of bacteria, as also, as shown by Marsden and Fowler, leaving little chance of the presence of a remnant of the bacteria inherent in the husk, which ordinarily assists in its disintegration during backwater retting. This characteristic will be referred to at length, later, as it is the basis of a new use for the fibre.

Chemical Properties

Very little is known as to the chemical nature of the coir fibre, and analysis shows considerable variation according to the retting, the type of nut and the origin. Sampson's figures for fresh and retted husks are already quoted. In the "Analyst," 1924, pp. 430-431, Mitchell stated that his analysis showed that coir fibre prepared at Mitcham contained 0.013 per cent. of soluble chlorine, whilst Ceylon fibre, according to the same observer, was returned as having 0.019

per cent. Dawson in the same report gave his figures for another sample as being 0·07 per cent. of soluble chlorine, whilst yet another analysis gave the figure as 0·017 per cent. The salt content apparently is influenced by the nature of the retting liquor, a factor which does not come in where chemical retting is employed. Copeland gives figures for the actual mineral content of the ash of the husk showing them to be—

Nitrogen	..	..	..	..	1·609	gms.
K ₂ O	..	..	..	..	3·915	„
P ₂ O ₅	..	..	..	..	0·017	„

He further quotes the following figures for the mineral content of the ash of the husk as due to Bachoffen and Lepine, the former apparently based on an unripe nut.

	Total Ash % of total wt. of nut.	By Lepine. % of total ash.		Total Ash.	By Bachoffen. % of total ash.	
		Salts of K.	Calcium Phosphate.		Potash (K ₂ O).	Phosphoric acid.
Husk ..	6·08	73·69	0·98	1·63	30·71	1·92

Copeland remarks that the coconut uses both in its products and in its body a conspicuously large amount of potash, and further “ to a less conspicuous degree as compared with crops in general, the coconut ties up in its own substance and in its products an appreciable amount of nitrogen. To a still less extent, as compared again with crops in general, it removes the phosphorus of the soil.” Copeland’s book may be referred to for further details on these points which are outside the scope of the present work. There is one other factor which should be considered in regard to the husk, namely the tannin which is obtainable therefrom. Grove Palmer remarks that the tannin present in the fibre serves the purpose of a mordant for basic dyes, and there is, in consequence, no necessity for this part of the dyeing process. Choudary quotes some interesting figures with regard to tannin. He shows that the ratio of tannins to non-tannins in the husk is very low, being 0·2 to 0·4 and the percentage of extractable tannin on the weight of the husk is about 1·3 per cent., a very low value. Bulletin No. 32, Department of Industries, Bengal, found

the ratio of tannins to non-tannins to be 0·2671 and the percentage of tannin extracted on the weight of the coir as 0·74 per cent. They concluded that "the substance is of no use for the tanning of leather." This is correct, but as shown above, the tannin may have its own function in the dyeing of the fibre.

One cannot help remarking once again on the paucity of the chemical information regarding the fibre. Although it is dyed and made into fabric for carpets, etc., the chemistry of the fibre is practically unknown, as also its physical structure. It seems to afford another instance of a raw material which has fallen into an obvious method of utilisation without any attempt at exploitation. Knowledge is wanted for the latter, and until it is available, the industrial development in new direction is seriously retarded.

Uses of Coir

A review of the qualities of Coir as set out above reveals its obvious uses. For ropes it is to be recommended where elasticity or resistance to decay is especially desired, in fact, on account of its ability to withstand the prolonged action of sea water, it has been extensively used in the Orient for making rope and cordage from time immemorial, dating from long before the discovery of Ceylon by Europeans. It served not only for rope and cables but also for fishing net cord, for tying the rafters and cadgan roofs of houses, to caulk boats, for mats and matting and in numerous other ways. The native fisher folk found its property of swelling when saturated with water, and hence giving a tighter joint, combined with its durability, a great asset in boat building and caulking.

On the other hand, its brittleness and its low tensile strength as ordinarily produced placed distinct limitations upon its use. Copeland remarks that "as a textile fibre it is of very little general value because of its coarseness, harshness, brittleness and colour". The qualities of harshness and stiffness and dark colour, all make it an especially good material for door mats, hall mats, matting and "for various kinds of brushes."

Thus its limitations have been prescribed and left largely at that. A glance at chemically and mechanically retted fibre quickly reveals a new vista in the outlook for the future of coir. Research is needed to find if these qualities cannot be modified in some degree, whilst its

good characteristics are maintained. The foregoing facts and figures indicate the start of such work and yet the fringe is as yet unruffled. Hayes-Gratze claims, with some justification, to obtain a lighter product as regards colour. His coir has been so softened as to spin and weave on jute machinery to produce yarn of fineness not before attained with coir. Van der Jagt has spun and woven coir to make gunny bags similar to jute sacks for sugar bags, etc., although the colour was as dark as usual. Such processes, enabling the coir to be spun and woven into softer and more flexible fabrics obviously opens out new uses for it. One of these has now passed the experimental stage successfully, namely, the use and preparation of protective lagging materials for underground pipes, such as gas, oil or water pipes and cables, subjected ordinarily to the corroding influences of bacteria, electrolytic action for tramways, etc., and chemical corrosion from the clay and soil itself in which it is buried.

When one considers the expense involved in repairs to corroded pipes, the pulling up and restoration of a road surface, the traffic delays, etc., it is obvious that modern science must assist in relieving such economic waste. Coir, retted chemically and cleaned mechanically so as to be perfectly free from bacteria or adhesive matter likely to decay, probably affords the solution. It resists decay, bacteria do not disintegrate it, water has no derogatory effect, it is easily impregnated with tar, bitumen, etc., or other insulating materials and now that it can be obtained in carded sliver form with a greater degree of softness and pliability than ordinarily or previously possible, it can be used for such purposes without weaving. If woven, coir presents a fabric of considerable strength, able to withstand the tension of winding and capable of use in band or ribbon form. Softened coir can be used for production of fabric for bags for sugar, etc., produced on machinery similar to jute and there also opens out possibilities for it in carpet manufacture. It must not be thought that retting problems are solved and nothing more is to be done.

The Journal of the Textile Institute, June, 1933, records an interesting experiment recently undertaken by the Indian Jute Mills Association involving the use of jute cloth in road surfacing:—
“ The process briefly is that the road surface, after being scraped and cleaned, is coated with bitumen ; it is then laid with jute fabric—in this case 40”/8 oz. hessian—which is thoroughly rolled to make it adhere to the road surface. The fabric is then again coated with

bitumen, covered with a layer of fine stone metal, and rolled so that the upper coating of bitumen penetrates the cloth and forms a solid mass with the bitumen underneath, and at the same time the stone chips adhere to the bitumen and fabric, producing the wearing surface.

“ Experiments on similar lines have, it is understood, been carried out in Germany and elsewhere, with the object of finding an additional outlet for jute goods. ‘ An experimental stretch of road which was built with jute last summer near Neckars, Ulm ’—states a report on one of these experiments—‘ is behaving exceptionally well, and in fact retains a better appearance than another stretch of road which was built at the same time without jute cloth. This latter, a tar road, has sweated considerably during the hot weather, so that split and sand have had to be strewn on it from time to time. The jute stretch, on the other hand, has so far remained perfectly dry and has needed no repairing. A few weeks ago the whole of the road, with the exception of the jute stretch, had, indeed, to be treated with tar and gravel, and the cost of this work amounted to as much as the additional cost for building it with jute cloth would have been. It is therefore an established fact that the employment of jute cloth in road building renders the road more durable.’ ”

When one considers the superior durability and resistance to decay of coir, as well as its wonderful absorbent properties for pitch, etc., it is obvious that there is a use for coir as a road surface reinforcing medium which should be tried. Experiments in this regard are now being organised.

It is certain, however, that along the path of scientific research in the light of modern chemical and mechanical industries, progress and the future of coir must travel, and undoubtedly the application of ionised oils is one of the directions for coir investigations to be promoted.

On a small scale, i.e. the laboratory and semi-manufacturing scale, the products have vindicated many of the claims put forward by their sponsors, but there is often a long way to industrial success on a factory basis which has to be traversed from these points. Snags, economic and geographical, bestrew the path, yet it is well that such efforts be recorded even if only as an indication and sign-post to point out the way for future workers.

Subsequent Manufacturing Processes

A brief review of one or two factors concerning the processes to which coir is ordinarily subjected, are of interest. Choudary has recorded fully the method of hand spinning in vogue in South India. He records that "The spinning wheel consists of two frames, one of which contains two spindles and is stationary in one end of the spinning yard; the other contains one spindle and is mounted on three wheels and can be moved forwards and backwards.

Two (grown up) persons (spinners) and a girl or a boy to turn the stationary wheel, are required to work on a pair of wheels. The spinners who are generally women take a bagful of fibre each in their left armpit, stand in front of the stationary wheel and hook a little fibre to the two spindles. Then the person who sits at the back of the wheel rotates the wheel towards the left. The two spinners deliver the fibre which is being formed into yarn with the required thickness and walk backwards until the yarns in their hands reach the other wheel which is kept 60 feet distant at the other end of the spinning yard. The two yarns are joined together at their ends and the middle bend hooked to the spindle of the movable wheel. The stationary wheel is stopped rotating for a minute when the two yarns are united and hooked by one of the spinners. The same spinner introduces a triangular piece of wood grooved on two sides (called atchu) between the two yarns at the bend near the spindle. The other spinner stands at the back of the movable wheel to rotate it. The two wheels are now rotated simultaneously and quickly while one walks towards the stationary wheel keeping the two yarns passing through the grooves or channels of the atchu, when the yarns twist or double into coir yarn behind it. The movable wheel has to be moved forward as the length of the coir is shortened. When the person holding the atchu comes to the stationary wheel, he takes off the yarn from one spindle and joins it with the other and one mudi of coir is thus made. The coir yarn is now tied to two trees or posts erected on the ground for the purpose when the coir gets dried and stiff before the evening when it is folded and stored and bundled."

About 75 mudies or 25 lb. of coir is bundled into one bundle and is sent as such to the market. One hundred and twenty mudies of coir each 60 feet in length and weighing about 40 lb. are spun on a pair of wheels by two experienced women and a girl per day of eight hours. On the West Coast of India on the shores of the back

waters almost every house has at least one pair of spinning wheels and carries on the industry on cottage basis. There, with the high price of husks, they earn and live on it.

Choudary also describes the hand spinning of the superior type of coir without wheels, yielding about 3 to 4 lb. per diem of good uniform twist, colour and strength.

This, however, is not general practice and under modern conditions, especially for use in mats and matting, the spinning is done by the wheel in general. More modern plant is also available for spinning by machinery. Machines, power driven are available for spinning by hand in similar fashion to the wheel spinning described above. The spinner, standing or sitting in front of the machine, has the fibre round his waist, and he regulates the quantity of fibre passing to the machine by hand, as so to form a thread of yarn of the thickness he requires. This yarn is twisted by the machine, drawn in, and wound on to the spinning bobbin. These machines are generally made in two sizes, the small one for spinning weaving yarns and the larger one for spinning rope yarns.

A multiple head machine of similar type is also available. Rope machines, balling machines, etc. are familiar to all larger concerns.

With regard to weaving, it has already been recorded that for the chemically and mechanically produced coir the power looms, ordinarily associated with jute can be used. There are, however, recent developments even in this direction which are as yet on trial for coir retted by the ionised oil or other processes. With regard to mat making, Grove Palmer records that a useful loom frame for mat making can be fitted with a warp roller instead of a creel for fine work, thus preventing the chafing of the yarn. It is claimed that such a machine is self-supporting, requires little fixing and is easier to work than the ordinary loom. He also describes a form of cropping machine fitted with dust proof ball bearings. A treadle lifter allows the operator to lift the cutting unit very slightly with his foot, while his hands are free to manipulate the mats. A dust extraction plant is also incorporated, thus rendering the waste available for other uses, fuel, etc.

It is not intended to dwell upon this side of the industry further since, in other branches of textiles, weaving and weaving mechanism is well advanced, and if the fibre can be obtained in more suitable form to be worked profitably on a higher production basis of weaving, then such improvements and advances will inevitably follow. This, therefore, once more turns our attention to matters of production and

treatment of the raw fibre, i.e. the retting involving the chemical, mechanical and bacteriological factors concerned therewith. Truly work of investigation for all branches of scientific thought and effort.

Bleaching

Copeland remarks that chemical bleaching is often practised to render the fibre a better colour. In the use of ionised oils, the paleness of the fibre is a matter of degree and time of treatment.

In his article in the American Dyestuff Reporter (Vol. XVIII, No. 21, 1929) Grove Palmer gives two methods for the bleaching of coir fibre. He also indicates certain improvements which have been made for rendering the fibre suitable for dyeing. He states that the method of bleaching varies slightly according as the fibre is coarse or fine ; the difference lying in the greater strength of the solutions required in some cases for the coarser kinds and in others in the longer time of exposure to their action.

For coarse fibres he recommends that after soaking for 24 hours in boiling water the fibres should be macerated with 3 changes of liquor consisting of boiling caustic soda solution for six hours in each case. He then soaks the fibre with hydrochloric acid solution and after such preparation he bleaches the fibre, by immersion for 18 hours in water, with chloride of lime and afterwards plunging it again into a hydrochloric acid bath before washing off and drying.

For finer fibres he recommends a similar procedure but with more dilute liquor and less time of contact therewith.

Grove Palmer further states that " Owing to the colour of coir, the fabrics that are made from it cannot, of course, be dyed in delicate pastel shades ; full bright tints are obtainable, however, as well as those of a duller nature, and for these dyes belonging to the basic, substantive, acid and sulphur classes are all available. In order to overcome the impenetrability of the fibre, a process has been brought out (German Patent No. 428,038) for the purpose of assisting the dyer. This consists of steeping the batch in a bath containing 2 per cent. or 3 per cent. calculated on the dry weight of the goods, of sulphite cellulose lye obtained from the paper mills."

He states, however, that on coir, none of the basic colours are very fast to light, whilst there are very few of the large range of substantive dyestuffs unsuitable for the fibre. They penetrate the fibre easily, and give good results as regards fastness to water, light and abrasion. With acid colours, shades are obtained which are faster to light,

washing and rubbing and also which are brighter, giving more brilliant tints, in some cases, than the basic colours. When, however, coir fibre is to be dyed with colours very fast to light and brilliance is of secondary importance, sulphur dyes, within a limited range are used.

Grove Palmer's original paper should be consulted for lists of suitable dyestuffs of the different types as well as useful hints in dyeing technique. Here is afforded a tremendous scope for fundamental research, for without knowledge of fibre composition and structure, its dyeing properties cannot properly be assessed.

The Shell

The present uses of the shell of the coconut are as diverse as the ingenuity of man can possibly make them. Mostly they are used for fuel. During the war large quantities were used for the production of charcoal. Let us consider the products of destructive distillation of the coconut shell.

A still designed for the destructive distillation of the shell is not an expensive item and the experiments described below were carried out in such an apparatus capable of yielding 5 gallons of pyroligneous acid per day. Facilities were provided for the removal of tar and the charcoal obtained. The distillate yielded pyroligneous acid containing small quantities of methyl alcohol, acetone, tar, higher organic acids, and a good proportion of acetic acid. The product was fractionally distilled, with the following results.

1st fraction.—87° to 98°. Methyl alcohol and acetone chiefly. 10 per cent. of the liquid was distilled over this range.

2nd fraction.—98° to 115°. Contained acetic acid. 85 per cent. of the liquid was distilled over this range.

3rd fraction.—Tarry residue for the remaining 5 per cent.

The second fraction was filtered over charcoal several times, the resulting liquid containing 7.75 per cent. of acetic acid. The sample was now redistilled with $\frac{3}{4}$ per cent. of its weight of potassium bichromate (or potassium permanganate), and the first 2 per cent. by volume rejected as being slightly coloured. The next fraction was collected up to a temperature of 115°C., at which temperature all the acid portion volatilised, leaving a small charred residue. The loss in this portion of the process was negligible. This pure sample of liquor

was practically free from all aromatic substances and contained 10 per cent. of acetic acid; 44 lb. of shell yielded $7\frac{1}{2}$ lb. of 10 per cent. acetic acid, and 13 lb. of charcoal.

The value of the pure vegetable charcoal needs no comment. For medicinal filters, and a variety of other uses, it commands a high price. During the war large quantities were used, and apart from medicinal purposes it has a wide field in other directions. It is too valuable a product to be lost.

Bunbury has pointed out that valuable products may be obtained by destructive distillation at a temperature of about 550°C. The nature and yield of these may be seen in the following tabulation:—

	<i>Per Cent.</i>
Moisture	7·60
Total distillate	46·40
Charcoal	35·20
Gas	18·40
Acetic acid	5·79
Methanol	1·12
Tar	5·80

The acetic acid yield is notable.

Other methods of Utilisation.—The ingenuity of the native craftsman has resulted in the use of the coconut shell in a large variety of ways. With a handle attached it acts as a ladle, it is used as a cup, and it is also used as a receptacle for the catching of rubber latex, etc. The wood of the shell is hard and capable of taking a high polish. The property renders it suitable for the manufacture of buttons, an industry that has met with a small amount of success in certain places.

According to Sampson, the amount of shell available can be estimated at about 1,000 lb. per acre per annum on a plantation. Where genuine sun drying of copra is carried out, as in South India, this may be regarded as a waste product but in other places especially where the crop is grown on a plantation scale, copra is prepared in hot dryers, heated by artificial heat and coconut shells are the usual fuel employed. They are ready to hand and cheap and it is probable that such a use in these instances is the most economic. Van der Jagt stresses the point in his process and utilises all forms of waste for thermal purposes, both for coir and copra drying. If the retting of the fibre became a factory industry, then co-ordinated with copra drying, this scheme might eventuate, appropriate for any form of chemical and mechanical fibre separation on a large scale.

Before leaving the subject of the shell an analysis of the ash due to Copeland is of interest from the manurial point of view.

Ash Analyses

Grams, average, in one nut at San Ramon

	N.	K ₂ O.	P ₂ O ₅ .
Shell	0.660	0.947	0.459

Conclusion

The object of this memorandum has been to show how little real scientific knowledge we possess of the coconut fibre.

Scientific investigation of coconut products is a correlated study. There is probably no industry in the world with greater wealth of raw material untapped, no industry so ripe for the application of scientific method and research, no industry where economic production of the manufactured articles could be so accelerated by more careful treatment of raw material. The *via media* is clearly scientific research, hand in hand with close application of the findings therefrom under practical conditions.

A quotation from Bulletin No. 30 of the Department of Industries, Madras, issued in 1931, records a truth which merits careful consideration in relation to coir. It reads :—" There has never been as careful a study of the source of coir and of the natural qualities of the husks of the coconuts under the different conditions as the importance of the product would justify."

At the beginning of their note on the retting of the coconut husk, Fowler and Marsden complain " There is practically no literature on the subject of coir-preparation." This is still the case.

This report is an attempt to begin the application of the remedy for this lack of knowledge and is a modest attempt to sow the seed of scientific research to accomplish this end.

When one contemplates the hidden wealth of our Empire with regard to vegetable fibres, as yet undeveloped in forests and plantations, and untried in commerce or industry ; and if the potentialities of those fibres in new directions could be visualised, fibres which have, in the past, found favour on the market but which, in the light of modern competition and the orientation of fashion or usage in other channels, have become victims of depression, then it would be realised that such attacks on the prestige of a raw material for a

world's industry can only be met by intensive study and elucidation of fundamentals leading to the fullest possible exploitation, perhaps along paths not even dreamt of at present.

The essentials for the development of modern industry, scientific origin, scientific method and scientific uniformity of production and product, must be applied to coir. In the past, coconut fibre, in company with many other fibres has withstood competition from synthetic filaments largely because it was comparatively cheap. The day is over for haphazard agricultural or industrial methods, and if coir is to remain an asset to the East, then along with other coconut products, its fundamental characteristics must be explored by scientific research, thus yielding, as already in the case of coconut oil, knowledge for the development of new products for the amenity of mankind. It must be remembered that the coconut oil industries are of comparatively recent growth and their success directly resulted from scientific research and exploitation. What new future uses may be in store for Coir if properly treated and rendered into a form suitable for the dictates of modern requirements?

In conclusion, therefore, let us all seek to stimulate the desire for scientific research into, not only Coir, but all other vegetable fibres of commerce used similarly. Successful issues from such research will only be attained if such investigation and exploitation is begun immediately for as in other things in life, delays are dangerous.

Acknowledgements

The author wishes to acknowledge with grateful thanks the assistance he has received from many collaborators. In particular he would recall the work of Mr. E. V. Hayes-Gratze of London, of Mr. Van de Jagt of the Hague, Holland, and Dr. D. R. Nanji, who have co-operated in practical experimental work with successful issues as regards products. Also his thanks are due to Mr. C. A. Masterman, Chief Chemist to the Gas Light and Coke Co., Ltd., London, for helpful advice and work on the durability of Coir, as also to Mr. J. K. Anderson, of Messrs. Fairbairn Lawson Combe Barbour, Ltd., of Leeds, for carrying out much practical experimental work in spinning and weaving the products obtained by various systems of retting. To Dr. H. C. Sampson, of Kew, London, to Dr. E. Goulding, of the Imperial Institute, London, and to Mr. F. A. Stockdale, of the Colonial Office, London, the author is grateful for

candid criticisms and helpful facts. He also wishes to thank the Research Control Committee of the Wool Industries Research Association for according him permission to write the Report.

He would also include in such thanks his colleague, Mr. Arnold Frobisher, Secretary of the Research Association, for his help and encouragement during the work. He owes a deep debt of gratitude to Mr. E. M. H. Lloyd, of the Empire Marketing Board, of London, through whose initiative and encouragement the work has largely proceeded. The author's thanks are accorded to Mr. I. G. Evans, of the Department of Scientific and Industrial Research, for facilitating useful contacts for the promotion of experimental work. Finally, the author would acknowledge the patient and careful services of Mrs. G. M. Glead for her assistance in preparing the manuscript.

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BANANA STORAGE

An Account of recent investigations into the
Storage Behaviour of several varieties

By

CLAUDE W. WARDLAW, Ph.D., D.Sc., F.R.S.E.

and

LAURENCE P. MCGUIRE, Ph.D., M.Sc., D.I.C.

Low Temperature Station,
Imperial College of Tropical Agriculture,
Trinidad, B.W.I.



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PREFACE

THIS Report is the fourth which Drs. Wardlaw and McGuire have written on the progress of their investigations into the effect of storage and transport conditions on certain varieties of West Indian bananas. The previous Reports were published in this series of E.M.B. "Grey Books" in 1931, 1932 and 1933 (E.M.B. 36, 45 and 60) and, together with the following account of further experiments, record the first stages of a piece of long-range research which forms part of a threefold attack on the main difficulties of the West Indian banana industry. This was among the earliest of the problems with which the Board has been concerned; and, although the present Report on the progress made in one branch of the tripartite research will be the last on this subject to appear under the auspices of the Empire Marketing Board, it is rather an interim note of work still in progress than a final estimation of complete results.

The importance of the banana as an economic crop in the West Indies (and in other parts of the Empire as well) needs no emphasis. It is grown both for local consumption as well as for export. In order to make export crops of bananas profitable the growers must be able to keep their production costs at a reasonable figure and at the same time to deliver to the consuming market fruit exactly fit in appearance, flavour and storage qualities for easy handling and ready sale. These two requirements are hard to combine; and, until the present comprehensive research was put in hand, there were such large gaps in the scientific knowledge of the subject that the prospect of more than a rule of thumb solution of the difficulty was remote.

The West Indies grow an excellent variety of banana—the Gros Michel—which behaves admirably in storage and transport, arriving in the British fruiterers' shops in an attractive state of ripeness. It is, however, susceptible to Panama disease, a virulent fungal rot which devastates even the best situated and the best tended plantations. Other difficulties arise with this as with all crops, but Panama disease is by far the most formidable. The attempts which have been made by the Imperial College of Tropical Agriculture, with the aid of grants from the Empire Marketing Board, to discover a banana at once resistant to Panama disease and as suitable as the Gros Michel for the export trade, have followed three main lines. The fungus which causes Panama disease—*Fusarium Cubense*—and the conditions which favour it have been studied by Drs. Wardlaw and McGuire, who made a tour of banana growing countries in the

Caribbean area reported in E.M.B. 20. Secondly, an endeavour is being made to utilise the knowledge obtained from this research by breeding strains of bananas immune to Panama disease. A Report on this work, by Professor Cheesman, has been published as E.M.B. 47. The third of the convergent lines of research, a stage of which is described in this Report, is the study of the behaviour of the immune varieties in storage and transport, with a view to discovering a variety which, like the Gros Michel, will be able to travel uncrated in naked bunches, and which will succeed—where the Gros Michel fails—in escaping the ravages of Panama disease.

While it is too early to say that the desired new variety has yet been discovered or produced, or that the effect of changes in the technique of harvesting and storage have yet been adequately studied, valuable data have been obtained. The Giant Governor, which the investigators believe to be a tall mutant of the Cavendish, often called the Canary banana, has been found to display many of the qualities which fit the Gros Michel for trans-oceanic shipment—shape, symmetry, and toughness of skin—while the experiments here recorded have shown how the ultimate condition of this variety—as regards flavour, colour, etc.—can be improved so as to approach the standard of Gros Michel. Promising results have also been obtained with a rather more delicate hybrid variety, bred at the Imperial College and known as I.C.2; and further trials with this variety, which possesses many of the more attractive qualities of the Gros Michel, are recommended. One valuable contribution to the subject of banana research, which the authors have been enabled to make in the course of their work, is the simplification of the nomenclature by the discovery that many of the names in current use refer to what are, in effect, only a few varieties.

While much has been done by the research so far done to clarify the subject and particularly to indicate the most promising lines for future study, this series of experiments is by no means ended. The E.M.B. takes leave of the authors, in publishing this Report, with the hope that the work will be continued to the benefit of the West Indies and of the Empire as a whole.

PLYMOUTH,

Chairman of the Research Grants Committee.

Empire Marketing Board,

7th September, 1933.

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE,
Low Temperature Station,
Trinidad, B.W.I.

July 8, 1933.

The Empire Marketing Board.

Gentlemen,

I have much pleasure in submitting, on behalf of Dr. McGuire and myself, a report on further investigations into the storage behaviour of bananas.

We consider that the research embodied in this Report constitutes an important advance in our practical knowledge of banana problems. Not only have we examined in some detail the storage behaviour of a new and potentially useful variety, the Giant Governor, but also, for the first time, we have been able to make comparative observations on the new College hybrid known as I.C.2. Further, by a careful study under controlled conditions of temperature and humidity, it has been possible materially to advance our knowledge of the botanical affinities of such difficult and widely spread groups as those represented by the Dwarf Cavendish and Lacatan varieties.

In submitting a report under present circumstances of difficulty and uncertainty, the writer would like to express his sense of the helpful co-operation, encouragement and unqualified support he has received from Members and Staff of the Board during the past five years—a sentiment in which he is sure Dr. McGuire is in full agreement.

I have the honour to be,

Gentlemen,

Yours respectfully,

CLAUDE W. WARDLAW,

Pathologist.

BANANA STORAGE

I. INTRODUCTION

In recent investigations at the College Low Temperature Station, further storage trials have been undertaken with a number of banana varieties to determine their behaviour under commercial conditions, and to assess their value and suitability for export. In these experiments the following varieties, in large or small quantities as material became available, were kept under observation : the Giant Governor ; the Trinidad Governor or Cavendish variety ; various Cavendish types ; Fillbasket ; Gros Michel ; the College Hybrids I.C.1 and I.C.2 ; an assemblage of tall types including the Giant Fig, Lacatan, Bumulan, Martaban and Masak Hijau.

II. THE GIANT GOVERNOR

This interesting variety, locally known as the Giant Governor, is apparently a tall sport or mutant derived from the ordinary Dwarf, Cavendish or Governor variety.* In the field, under average conditions, it is a plant of intermediate stature, much taller than the Dwarf, but definitely not so tall as the Gros Michel or Giant Fig. The stout trunk or pseudo-stem is strongly reminiscent of the Dwarf variety from which it is thought to have originated (Fig. 1).

The fruiting characters show some points of interest. Immediately below the female flowers there is a region of the fruit stem from which the male flowers and bracts drop off ; lower down, near the compact bud, adherent bracts are again encountered. In general, though not in all cases, the bunch habit shows some departure from the normal dwarf type ; as a whole it tends to be more cylindrical, the vertically upturned hands being less spreading. The fruit skin is also more resistant to mechanical injury. In short, other things being equal, the bunch habit is much more suitable for naked bulk transport than the ordinary Dwarf type (Figs. 2 and 3).

The fruit used in these investigations was obtained from a Maqueripe estate. The plantation, situated on a light sandy loam, was established from suckers and bits gathered from the Moruga

* For an account of mutant types of the Dwarf banana, readers should consult Professor E. E. Cheesman's paper (1).

district. Side by side in the same area the Trinidad Governor or Dwarf variety has also been planted. Although both received the same manurial treatment, namely, a basket of pen-manure at the time of planting, the response of the two varieties was very different indeed. In the case of the Governor variety, bunches of moderate size only were obtained, whereas the Giant Governor responded vigorously, and has consistently produced remarkably fine, well-developed bunches. Experience will show whether this holds good for other soil types also.

So far, four bulk storage trials have been carried out with the Giant Governor, the Dwarf or Trinidad Governor from the same and other areas being included for comparison.

First Trial.—On arrival at the Station, the bunches, 50 in all, after having their stems re-trimmed and vaselined, were labelled and given a serial number to facilitate inspection during ripening. At the commencement of loading, the storage-chamber air temperature was 53.4° F. ; 3½ hours later, on completion of loading, the air temperature was 66° F. This was cooled to 53° F. in 28 hours. The chamber was blown out for ten minutes at 6 a.m. and 6 p.m. daily.

In this trial, bunches of the Giant Governor were selected which approximated closely in size and "fullness" to the standard "¾-full" fruit exported from the Caribbean region to English markets, but bunches decidedly more and less than "¾-full" were included for the purpose of accumulating data on the question of maturity in relation to storage behaviour and the rate of ripening.

As the storage trial proceeded it became evident that a good many of the bunches—plant bunches—which appeared to be approximately "¾-full," were obviously more immature, as indicated by their slowness in ripening. In this connection two possibilities have to be considered: (i) this variety may be better suited by higher storage temperatures or (ii) grown rapidly as the result of manurial treatment, the plant may have acquired unusual vigour, and, in consequence, judgment of maturity by the usual criteria was inaccurate. Unfortunately, ratoon bunches were not available.

After 18 days at 53° F. the fruit was transferred to the ripening room maintained at 70° F. The following points were noted (Table 1), parallel observations on the Governor being made as a standard of comparison:—



FIG. 1.—Giant Governor plant with half-full bunch. Note stature of plant.



FIG. 2.—Young bunch of Giant Governor. Note its cylindrical shape.

(Figs. 1 and 2 by courtesy of Messrs. F. W. and P. Urich.)

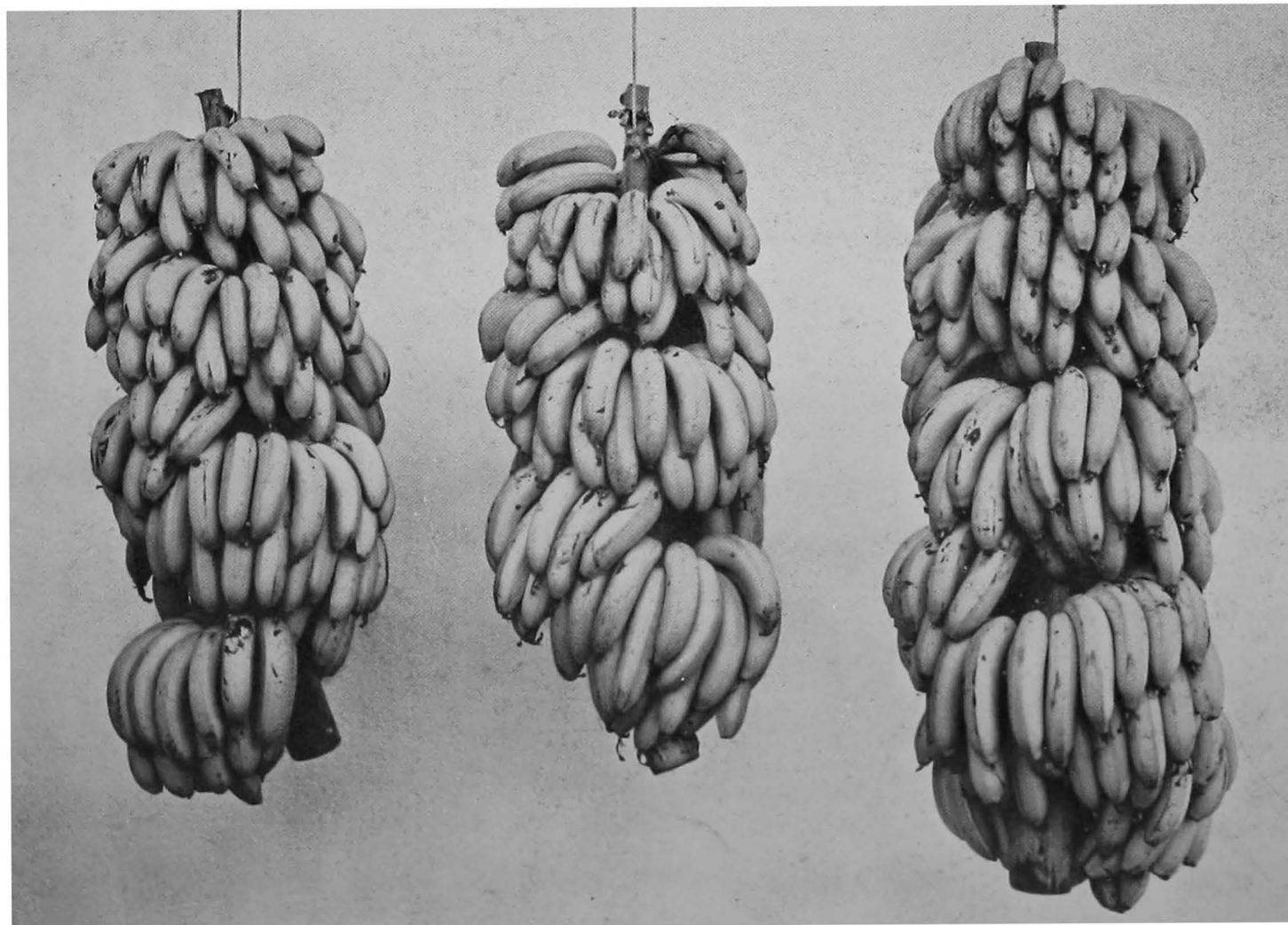


FIG. 3.—Good commercial bunches of Giant Governor, reaped at the correct stage of maturity for transport to British and European markets. (2 nine-hand bunches and one eleven-hand bunch.) This photograph was taken when bunches were being removed to the ripening room.

TABLE 1

	Giant Governors.	Ordinary Governors.
<i>Main-stalk rot</i> ..	15 per cent. showed slight rotting.	13 per cent. showed slight rotting
<i>Pitting disease</i> (4) ..	24 per cent. of the bunches showed some pitting : 13 per cent. very slight, 5 per cent. slight, and 6 per cent. severe.	50 per cent. of the bunches showed some pitting : 6 per cent. very slight, 31 per cent. slight, 6 per cent. severe, and 7 per cent. more severe.
<i>Mechanical injury to top and 2nd hands.</i>	5 per cent.	61 per cent.
<i>Ship-ripes</i>	None.	None.

Two bunch habits appeared to be represented in this collection of Giant Governors. One had a typical truncated-conical habit with curved fingers like the ordinary Governor, whereas the other approached the cylindrical habit of the Gros Michel with fingers folding back towards the central axis (Fig. 3). In later consignments from the same area all the bunches were of the cylindrical type, suggesting that the conical bunch habit is related to cultural conditions or to the physiological status of the plant during the period when the bunch is being formed or developed. Some of the Giant Governor bunches in this consignment had very flexible stems, perhaps due to rapid growth, but in spite of this they showed less transport injury than the ordinary Governor.

Ripening at 70° F. was very slow compared with the ordinary Governors (Table 2).

TABLE 2

	Giant Governor.	Governor.
Bunches ripened by 8th day	27 per cent.	75 per cent.
Bunches ripened by 15th and 12th days respectively.	31 ..	100 ..

After 15 days, 69 per cent. of the Giant Governor bunches had failed to ripen, and were developing a dull russet colour. It was concluded, therefore, that what had appeared to be a standard grade

of fruit was definitely too immature for such storage conditions. On the other hand, of the ordinary Governors, 75 per cent. were ripe on the eighth day and the remainder four days later.

The outstanding feature of this first trial was the fact that the cylindrical bunch habit of the Giant Governor enables it to stand up well to local transport and storage while the fruit skin seems definitely more resistant to bruising than that of the Governor.

The ripe fruit was of good quality and pleasing in flavour and texture; those bunches which ripened during the first 10 days at 70° F. were of quite attractive external appearance.

Second Trial.—Fifty bunches of Giant Governors and sixty of ordinary Governors from Macqueripe were carefully packed in trash, transported to the Station, and, after the customary re-trimming of the stem, were loaded into a chamber maintained at 53° F.

The Giant Governors were placed on the lowermost tier and the ordinary Governors superimposed by way of again testing the resistance to bruising shown by the former in the preceding trial. This consignment was more uniform than the first, practically all the bunches being approximately “ $\frac{3}{4}$ -full.” The Giant Governors were of excellent bunch habit, and for the most part did not have the hands spaced so far apart, bearing out the assumption that wide spacing is cultural and attributable to rapid growth.

Temperature at commencement of loading was 54° F., and on completion 59° F.; after 12 hours, 53° F. was attained. After 17 days the fruit was transferred to the ripening room. After five days at 70° F. the Giant Governor bunches were subjected to a critical analysis. The details may be conveniently summarised thus:—

TABLE 3

<i>Main-stalk Rot</i> ..	No bunches showed any marked progression.
<i>Pitting Disease</i> ..	52 per cent. of the bunches showed some pitting: slight pitting, 20 per cent.; moderate pitting, 22 per cent.; severe pitting, 10 per cent.
<i>Mechanical Injury</i> to top and 2nd hands.	34 per cent.; the main stalk, despite its flexibility, behaved as in the first trial, none being broken by the weight of superimposed bunches.

There was a marked tendency in the top and second hands to lesions at the junction of the cushion and the main stalk, the lesions being possibly mechanical in origin. Again, in many bunches, presumably partly as a result of rapid growth and partly as a normal

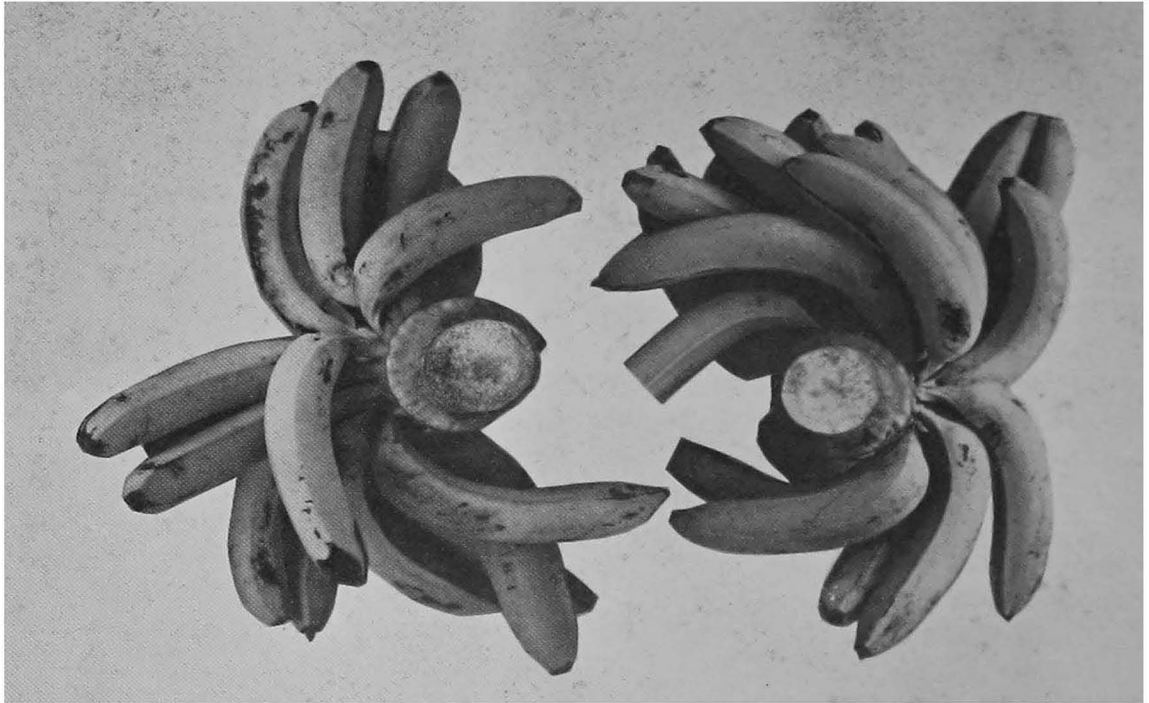


FIG. 4.—Top and second hands of the Giant Governor, illustrating the tendency of fingers to fall apart when bunches are held with the proximal hand uppermost.

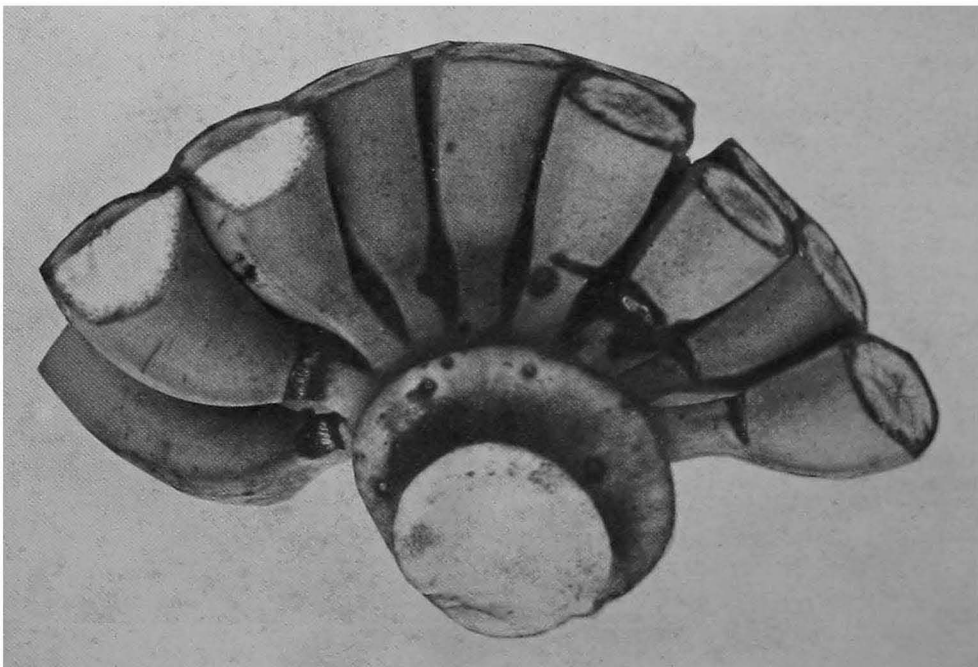


FIG. 5.—Mechanical notching of finger-stalks and pitting disease in the Giant Governor.

varietal characteristic, the individual finger stalks were very long ; where this was the case, many fingers showed slight transverse notching due to the shape and length of the fingers and to the upward and inward pressure during stowage (Fig. 5).

In bunches suspended with the large, topmost or proximal hands uppermost to facilitate inspection, both the cushion lesions and the mechanical notching of the finger stalks were responsible for some loss of marketable fruit through the rotting-off of hands and finger-dropping. In bunches suspended upside-down, i.e. with the heavy top-most hands downwards as is customary in the trade, such mechanical injuries were less extensively developed, and losses through finger-dropping were accordingly greatly diminished. In bunches liable to finger-dropping, the rate of ripening is, of course, the decisive factor in deciding whether or not such bunches can be disposed of profitably.

In bunches suspended with the large hands uppermost, a considerable number showed a marked departure from symmetry during ripening, particularly in the two top hands. The individual fingers which were rigid and upright at the time of reaping and during cold storage showed a marked tendency to sag down irregularly with the onset of maturity. This characteristic, illustrated in Fig. 4, is very similar to what was observed in other varieties such as Bumulan in earlier studies (2). While this departure from symmetry is interesting as a characteristic feature, it should not necessarily tell against the value of this variety, since, in the usual trade practice, the bunches are suspended upside-down and the original symmetry is easily maintained.

In this consignment, which was regarded as a good standard "¾-full" grade, the rate of ripening was again much slower in the Giant Governors than in the ordinary Governors (Table 4.)

TABLE 4.—Rate of Ripening (stated as percentages)

	Giant Governor.	Governor.
Bunches ripened by 5th day	0	22
" " 10th " 	24	75
" " 12th " 	60	92
" " 15th " 	84	100
" " 18th " 	92	—
" still green on 18th day	8	—

In short, on the tenth day 75 per cent. of the Governors, but only 24 per cent. of the Giant Governors were ripe. Such slow ripening would, of course, considerably increase warehouse and ripening costs.

On the whole the results of this storage trial were disappointing. Not only was slow ripening the rule, but at least 48 per cent. of the bunches developed abnormal colouration, including sooty or pasty colour in yellow fruit, and russetting of green fruit, characteristics which suggested chill effects or immaturity at the time of reaping. A further possibility that had to be considered was the question of humidity since, during the prevailing dry weather, low relative humidities (e.g. approximately 70-75 per cent.) had been the rule in our storage rooms. In the third storage trial, therefore, it was decided to raise humidities, to work with a more mature grade of fruit, and to divide the consignment into two comparable parts and store them at 53° F. and 58° F. respectively.

Third Trial.—As indicated above, the fruit used consisted of heavy mature bunches, which, by reference to the Gros Michel, would be described as “heavy $\frac{3}{4}$ -full” or even “full,”* being comparable to fruit shipped from the Caribbean region to American ports. The consignment was divided into two uniform lots which were held at 53° F. and 58° F. respectively. After 16 days the fruit was transferred to the ripening room at 70° F. Care was taken to maintain the relative humidity at approximately 85 per cent. The rates of ripening are shown in Table 5.

TABLE 5.—*Rates of Ripening (Giant Governor)*

Classification.	Fruit originally stored at 53° F.				Fruit originally stored at 58° F.			
	1st day	5th day	7th day	9th day	1st day	5th day	7th day	9th day
Green	84	46	20	12†	87	48	17	4†
Turning	16	33	29	} 80	9	48	43	} 83
Ripe	0	21	51		88	4	4		40	96

* If this grade of fruit, i.e. “full” Gros Michel, was stowed for shipment to English ports, many of the bunches would become “ship-ripes” before the conclusion of the voyage period.

† This represents bunches which were definitely more immature than the general consignment.

From these data it will be seen that the fullest grade of Trinidad Governor (i.e. ripening on the third day at 70° F., after only 11 days at 53° F.) is comparable with Giant Governor which did not ripen till the eleventh day. Normal "¾-full" bunches of the Governor, on the other hand, weighed only 151 gms. per finger against 253 gms. per finger in the Giant Governor ripening at approximately the same time.

Relation to Temperature.—As both lots of fruit were maintained at favourable humidities throughout the trial it was possible to assess critically the influence of the temperature factor. During ripening it was soon apparent that the fruit stored at 58° F. was considerably superior in colour and quality to that which had been kept at 53° F. In the former, the bright pale golden-yellow colour which developed was in marked contrast to the rather pale yellow and sometimes sooty or pasty colour of the latter. In short, most of the bunches held at 53° F. had definitely suffered from chilling. The quality of the yellow colour in ripe fruit and the development of a pasty or sooty appearance, particularly towards the distal ends of the fingers, were very similar to the chill effects induced in the Cavendish variety (Trinidad Governor) by exposure to low temperatures (3).

The fruit which had been stored at 58° F. not only coloured well, but its maturation, as shown by Table 5, was not unduly hastened by this temperature. Here it should be stated that ripening of the bunches from top to bottom proceeded uniformly and evenly.

In the light of this storage trial it was thought that a transport temperature of 56° F. would probably be well suited to this variety, and accordingly a fourth trial was undertaken.

Mechanical Injury.—On transference to the ripening room after 16 days at 53° F. and 58° F. respectively, the following observations were recorded (Table 7).

In commenting on these figures it is to be noted that only injuries or scarring described as "severe" would be such as to cause fruit to be graded as second or perhaps third class, while those described as "moderate" are normal to first-class fruit handled naked in bulk. The resistance of the Giant Governor to mechanical injury is again borne out by these figures.

Pitting disease, though present, only caused slight wastage in these consignments.

TABLE 7.—*Nature of Wastage*

Cold Storage Temperature.	Nature of Wastage.	Percentage.
53° F.	A. <i>Injury to top and second hands.</i>	
	(i) None	40
	(ii) Very slight	32
	(iii) Moderate	24
	(iv) Severe	4
	B. <i>General Scarring.</i>	
	(i) None	33
	(ii) Very slight	33
	(iii) Moderate	25
	(iv) Severe	9
C. <i>Pitting Disease.</i>	0	
58° F.	A. <i>Injury to top and second hands.</i>	
	(i) None	55
	(ii) Very slight	14
	(iii) Moderate	26
	(iv) Severe	5
	B. <i>General Scarring.</i>	
	(i) None	13
	(ii) Very slight	52
	(iii) Moderate	26
	(iv) Severe	9
C. <i>Pitting Diseases.</i>		
(i) Slight	26	

Fourth Trial.—In this trial heavy bunches were held at 56° F. for 18 days with subsequent ripening at 70° F., a relative humidity of approximately 85 per cent. being maintained throughout.

The following observations on the condition of fruit at the end of the cold storage period were recorded (Table 8) :—

TABLE 8.—(Results stated as percentages)

<i>Condition of Fruit.</i>					
Green	..	..	..	..	80
Turning	..	..	..	..	15
Ripe	..	..	..	..	5
<i>Injury to Top and Second Hands.</i>					
None ..	..	..	..	..	55
Very slight	..	..	..	..	35
Moderate	..	..	..	..	10
Severe	..	..	..	..	0
<i>General Scarring.</i>					
None ..	..	..	..	..	45
Very slight	..	..	..	..	25
Moderate	..	..	..	..	10
Severe	..	..	..	..	10

Rate of ripening is shown in Table 9.

TABLE 9.—Rate of Ripening in the Giant Governor Variety
(Results stated as percentages)

Classification.	Number of days at 70° F.				
	1st day (on transference)	6th day.	7th day.	8th day.	10th day.
Green	80	10	10	10	5
Turning	15	60	40	20	5
Ripe	5	30	50	70	90

The presence of "ship-ripes" on removal from cold storage and of bunches quite green after 10 days at 70° F. show the need for careful selection at reaping. In the event of this variety acquiring commercial status, it may be anticipated that some difficulty will be experienced at first in selecting suitable grades for shipment, particularly on certain soil types and during the dry season.

Discussion.—From the four storage trials described above it appears that the Giant Governor may be regarded with a certain amount of optimism. On soil which could not be regarded as being suitable for the Gros Michel, the Giant Governor produces large well developed bunches. These are cylindrical in shape, and the disposition of the fingers is such as to permit of naked stowage in bulk without undue loss through mechanical injury. Further, such fruit as has been available for experimental purposes possesses a much tougher skin than the ordinary Cavendish or Governor variety, and accordingly bunches suffer less from superficial bruising and scarring. In this respect, however, it cannot be claimed that the Giant Governor is the equal of the Gros Michel. This is partly due to the constitution of the skin in relation to wounding or bruising, and partly to the fact that fruits of the Cavendish group are inherently more subject to fungal attack than the Gros Michel.

Disadvantageous characters in the Giant Governor are concerned with questions of maturity and the temperature factor.

Even where a long period in cold storage is anticipated, fruit must not be reaped until it is heavy and almost fully developed. Instead of reaping at “ $\frac{3}{4}$ -full” as in the Gros Michel, Giant Governor bunches for transport to English or European markets should be “heavy $\frac{3}{4}$ -full” or almost “full,” otherwise delay and irregularities in ripening will certainly be experienced later. Such heavy bunches are not only liable to receive rather rougher handling, but as the individual fruits are of very large size they may prove less acceptable to certain markets.

With regard to the second factor, this variety requires a higher storage temperature than is at present customary in the Trade, and this may prove a difficulty, particularly in the inaugural stages when mixed consignments would have to be carried. Given careful handling and stowage and suitable protection against main-stalk rot, fungal wastage need not become excessive, even though fruit is being carried at a higher transport temperature.

From the strictly scientific point of view the foregoing studies should only be regarded as being of a preliminary nature. As supplies of fruit become available, further investigations should take into consideration the influence of different soil conditions and of different seasons on storage behaviour, the relative merits of ratoon versus plant bunches, the influence of manurial treatment, criteria of maturity to achieve greater uniformity in consignments, the effect of ripening at different temperatures and so on.

Before the final assessment of commercial suitability can be made, shipping trials must be carried out, and the fruit, subsequently handled and distributed by the usual brokers and agents, must meet with the approval of the public palate. It is to be hoped that such trials will be carried out under suitable supervision as larger consignments of fruit become available.

III. THE DWARF, CAVENDISH OR GOVERNOR VARIETY

By way of amplifying the observation on this variety already submitted (2), several consignments were taken into storage and held at 53° F.,

- (1) for comparison with the Giant Governor (see above) ;
- (2) to determine the influence of manurial treatment on the subsequent storage behaviour ;
- (3) to observe the behaviour (a) of " $\frac{3}{4}$ -full " bunches from parent plants affected with " Moko " or Bacterial Wilt disease, and (b) of the so-called " May " bunches.

Influence of Manurial Treatment.—Fruit for these experiments was obtained from the College Farm from a series of plots with different manurial treatments.

In the fruit from two plots, viz., synthetic pen-manure and those to which in addition there was added 2 lb. potash per stool, there appeared to be no difference, either in rapidity of ripening and senescence or in bruise resistance. In general it may be said that considering the initial unsuitability of this soil for banana growing, the parent plants have shown an amazing response to manurial treatment, as shown by vegetative vigour and size of bunch and fingers (5).

Almost without exception these bunches of rather turgid fruit have been very subject to bruising. This may be attributed to the rushed growth and perhaps to the long rainy season. Top hands have consistently shown mechanical damage despite the short journey to the Low Temperature Station, some 60–80 per cent. of the bunches being affected. From the several trials conducted it can only be concluded that fruit of this variety, grown with the help of fertilisers on relatively poor soils, is so subject to mechanical injury during transport that it is quite unsuitable for exporting as naked bulk consignments.

In general, bunches of the Governor variety from the College Farm ripened attractively within the usual time (Tables 2 and 4). The Governors from the Agricultural Experiment Station and from Woodford Lodge behaved much as fruit from these localities in former trials. They were not such large bunches, but ripened well, and were less bruised.

Bunches obtained from the College Farm and from Maqueripe Estate consistently developed pitting disease (4) in storage, while those from the Agricultural Experiment Station and Woodford Lodge did not.

Bunches from "Moko" Disease Plants.—Three "heavy $\frac{3}{4}$ -full" bunches from plants which had succumbed to "Moko" or Bacterial Wilt disease were included in a storage trial, and apparently ripened normally. This was perhaps surprising, but is probably accounted for by their being well advanced before disease overtook the parent.

"May" Bunches.—Numerous Governor bunches this season have exhibited in the top and sometimes in the second top hand a feature corresponding to the so-called "May" bunches of the Canaries, i.e. the fingers curve irregularly or lie in the horizontal plane instead of standing upwards evenly and in a plane more or less parallel to the central axis. In naked storage, these bunches are extremely liable to damage and breaking off of fingers. Physiologically they are obviously abnormal, and on ripening might be expected to show irregularities. In point of fact, however, though their colour was pasty they were of good flavour.

The following bunches, reaped at approximately " $\frac{3}{4}$ -full" from the variety plot of the Department of Botany, were held at 53° F. for 16 days with subsequent ripening at 70° F. This lot included 16 dwarf and two tall types of Cavendish of different origin. These are tabulated below (Table 11).

By the eighth day in the ripening room two were green, but commencing to colour, while 13 had ripened to bunches of pleasing appearance. By the twelfth day all had ripened.

Judged by their bunch habit, colouring, texture, etc., these dwarf Cavendish from various sources seem to be very closely related if not one and the same variety. The ripening behaviour of the tall varieties was such as to suggest a near affinity to the dwarf forms. Further detailed comparisons with larger lots of fruit are required.

TABLE 11

Tag No.	Type.	Field Label.	Origin.
A1	Dwarf Cav.	Governor, Trinidad	Trinidad
A2	"	" Barbados	Barbados
A3	"	" " "	" "
A4	"	" Tuffy "	Virgin Islands
A5	"	" "	" "
A6	"	Essequibo	British Guiana
A7	"	" "	" "
A8	Tall Cav.	Giant "Chinese	"Guadeloupe"
A9	"	Aranguez	Trinidad
B1	Dwarf Cav.	Cavendishiana I.	Canary Islands
B2	"	" "	" "
B3	"	Tuffy	Virgin Islands
B4	"	Canary	Canary Islands
B5	"	Sampson 7. 42	" "
B6	"	Governor	" B.W.I. "
B7	"	" "	" "
B8	"	" "	" "
B9	Tall Cav.	Congo	Trinidad

Notes :—Series A were grown together and are comparable.

Series B were grown together and are comparable, except that B6, B7 and B8 came from old stools less well grown than the rest.

All bunches about " $\frac{3}{4}$ -full " except A2 and A3 which were nearly " full."

IV. FILLBASKET

Several bunches of this variety were held at 53° F. for 16 days, then ripened at 70° F. Normally this fruit ripens attractively at ordinary temperatures. After the cold storage treatment, however, the colour intensity deepened, and the flesh had good texture and a pleasant flavour of its own. As this fruit, grown in the College variety plot, had been very carefully treated in its short journey to the Low Temperature Station, bruising was obviated. Judged by external appearance, these were quite the most attractive bunches, Gros Michel included, which we have had in the Low Temperature Station. The bunch habit and the very thin skin would, however, preclude rough treatment. It is thought that this variety might be given more attention during the tourist season, as their small fingers (Lady Finger type of banana) would make them a pleasing oddity. Unless quite mature, however, there is a danger that the pulp may appear too astringent for some palates.

V. GROS MICHEL

First Trial.—By way of confirming previous trials with this variety as grown under Trinidad conditions, a consignment of 30 bunches,* “ $\frac{3}{4}$ -full,” and ranging from 8 to 11 hands per bunch, was held at 53° F. for 17 days with subsequent ripening at 70° F. The ripening record is shown in Table 12.

TABLE 12

Number of days at 70° F.	Ripening of fruit (<i>stated as percentages</i>).			
	Green.	Turning.	Ripe.	Over-ripe.
1	100	0	0	0
5	16	40	40	4
8	13	7	76	—
10	0	7	89	—

Although this fruit had been transported more than 20 miles by lorry and stowed in bulk with bunches of other varieties, the fruit, on ripening, had good appearance, and, in the matter of bruising and scarring, was perfectly normal. As judged by commercial criteria the principal defect consisted in the tendency of some bunches to irregular ripening. Instead of the uniform ripening from the top to the bottom hand which is the rule in Central American and Jamaican fruit, the bunches showed either—

- (i) a group of the lowermost hands quite green while the uppermost hands were yellow and mature; or
- (ii) individual fingers in a hand at a different stage of maturity to their immediate neighbours.

As Gros Michel fruit for the best markets has reached a very high standard of uniformity, irregularities in ripening such as those described above would be regarded as a serious defect by the Trade. To what extent this unusual physiological behaviour is related to climatic or cultural conditions has yet to be determined.

* These were obtained from the Sangre Grande district.

A very mild form of pitting disease, but one which is economically important, was observed on the topmost hands of some bunches, the pits in finger-stalks and cushions being very minute and only in evidence as the fruit reached maturity.

Second Trial.—A second consignment of fruit from the same district was divided into two lots (A and B), stowed in bulk and held at 53° F., A for 16 and B for 21 days, with subsequent ripening at 70° F.

On transferring lot A to 70° F. the following observations were made (Table 13) :—

TABLE 13.—(Results stated as percentages)

<i>Appearance of bunches.</i>				
Green	..	..	..	74
Turning	..	..	..	26
<i>Injury to Top-hand.</i>				
None	..	..	..	46
Slight	..	..	..	47
Moderate	..	..	..	7
Severe	..	..	..	0
<i>Injury to second top-hand.</i>				
Slight	..	..	..	7
<i>Scarring.</i>				
None	..	..	..	26
Slight	..	..	..	33
Moderate	..	..	..	34
Severe	..	..	..	7
<i>Pitting Disease.</i>				
Slight (economically unimportant).				33

The ripening record was as follows (Table 14) :—

TABLE 14

Number of days at 70° F.	Ripening of fruit (stated as percentages).		
	Green.	Turning.	Ripe.
1	74	26	0
4	28	26	46
7	15	13	72

Some of this lot consisted of a rather heavy grade of fruit with concomitant rapid ripening. In the fullest bunches, ripening after two to three days at 70° F., it was found that chill effects were invariably present, the fruits showing the characteristic russetting which develops in this variety when over-refrigerated. In the standard "¾-full" bunches, ripening from the fifth day onwards, on the other hand, such chill effects did not develop. As it has been shown that chilling is a cumulative effect of duration of exposure to a given low temperature (3) it is evident from the foregoing observations that the transport of the more mature grades during long ocean voyages is attended with a considerable risk of wastage through chilling. The fact that "heavy ¾-full" and "full" fruit is consistently shipped, during the shorter voyage period, from Caribbean to American ports without chilling, confirms our previous finding regarding the importance of the time factor in this connection.

On transferring lot B to 70° F after 21 days at 53° F., the following records were made (Tables 15 and 16) :—

TABLE 15.—(Results stated as percentages)

<i>Appearance of Bunches.</i>				
Green	..	..	..	72
Turning	..	..	..	28
<i>Injury to top hand.</i>				
None	..	..	..	79
Slight	..	..	..	21
<i>Scarring.</i>				
None	..	..	..	15
Slight	..	..	..	56
Moderate	..	..	..	14
Severe	..	..	..	15
<i>Pitting Disease.</i>				
Slight (economically unimportant).				42

TABLE 16

Number of days at 70° F.	Ripening of fruit (stated as percentages).		
	Green.	Turning.	Ripe.
1 ..	72	28	0
5 ..	7	0	93

Again the more mature bunches which ripened after two to three days at 70° F. showed unmistakable signs of chilling, the normal yellow colour being partly masked by russetting.

With regard to the wastage in lots A and B, it is to be noted that only bruising or scarring described as "severe" would be such as to remove bunches from the first to the second or third class. In short, given the usual careful handling, there is no reason to suppose that Trinidad-grown Gros Michel is more susceptible to depreciation through mechanical injury than the same variety grown elsewhere.

In both lots, uneven maturation in the bunches was again a characteristic feature during ripening. As this tendency, in fruit otherwise excellent, would undoubtedly make for depreciation in its ultimate value, its occurrence, whether determined by seasonal or cultural factors, commends itself as a subject for further investigation.

VI. THE COLLEGE HYBRIDS I.C.1 AND I.C.2

Nine bunches of the new hybrid known as I.C.2, which is highly resistant or immune to Panama Disease, were reaped at approximately "¾-full" from plots in the College grounds and held at 53° F. for 16 days. Bunches of the Hybrid I.C.1 were also stored for comparison.

All the I.C.2 bunches were quite ripe before the eighth day in the ripening room at 70° F. Like the Gros Michel parent they acquired a good yellow colour and several independent tasters declared them to be good in texture and flavour and superior to the I.C.1. Furthermore this hybrid possesses the Gros Michel toughness of skin and resistance to mechanical injury and fungal wastage. On the other hand, the bunches so far obtained are rather small and the fingers short, thick and closely packed. As a result, fullness in fruit soon leads to distortion of the bunch habit so that additional mechanical injury may result. In general, the shape of the finger is more like the Giant Fig than the Gros Michel.

As these bunches were grown on indifferent soil, the results of this preliminary storage trial should not be regarded as affording a true indication of the commercial possibilities of this variety. Like the Jamaican hybrid this fruit is chiefly defective in the shortness of the fingers and further storage trials should be based on fruit grown on good soil. It will be interesting to note to what extent the characters commercially objectionable can be modified by agricultural treatment.

The I.C.1 bunches, introduced as a standard of comparison, behaved in a manner which confirmed earlier storage trials (2).

VII. THE GIANT FIG, LACATAN, BUMULAN, MARTABAN AND MASAK HIJAU VARIETIES

For some time past tall varieties labelled Lacatan, Bumulan, Martaban, Giant Fig and Masak Hijau have been grown in close proximity in the College variety plot with a view to determining their botanical affinities. Hitherto these varieties, known to other observers from plants grown under different conditions of soil and climate had been regarded as quite distinct and separate, though it was appreciated that they all possessed certain features in common. When grown side by side in the same or adjacent rows in the variety plot and kept under close observation, however, it was found that they were quite indistinguishable, and that no definite criteria could be selected by which one could be separated from another. From such data Professor Cheesman has put forward the suggestion that these so-called varieties are not distinct, but are, in point of fact, one and the same. It was thought that further light might be thrown on this point by testing their behaviour during cold storage and ripening. Accordingly, in a first trial, bunches, as described in Table 17, were held at 58° F. for 16 days with subsequent ripening at 70° F.

TABLE 17.—*Bunches sent to Low Temperature Station*

A.	Lacatan	..	..	..	..	82 days old.
B.	Bumulan	..	..	..	..	77 " "
C.	Masak Hijau	..	..	..	..	99 " "
D.	" "	..	..	..	..	98 " "
E.	Giant Fig	..	..	..	..	98 " "
F.	" "	..	..	..	..	98 " "
G.	Giant Fig	..	..	..	..	83 " "
H.	" "	..	..	..	..	87 " "
J.	Lacatan	..	..	..	..	90 " "

A and B were grown alongside, and are comparable.

C, D, E and F were all from one row. G, H and J were grown alongside, and are likewise comparable.

These bunches all had the appearance of fruit grown under rather unfavourable soil conditions. This was confirmed by the ripening data. The two bunches of Masak Hijau were quite ripe after 13 days at 70° F., and the Giant Fig bunches E and F of comparable age were ripe on the seventeenth day. The Lacatan bunch J was the next to ripen. With the exception of occasional fingers which had matured, all the other bunches were still green after 18 days at 70° F.

Apart from these variations in the rate of ripening which are to be expected when dealing with individual samples, the bunches showed a number of features in common.

(1) All possessed a rather thin and weak main-stalk and showed a marked tendency for individual finger-stalks to suffer from mechanical injury and subsequent *Gloeosporium* infections.

(2) The tendency of the fingers of the top most hands to fall apart in an irregular manner when suspended with the proximal hand uppermost was common to all.

(3) Slow or delayed ripening of the rather thin fruit.

(4) All fruits which ripened developed a clear, pale-yellow colour ; with the onset of late maturity a characteristic freckling, quite similar in the several varieties, was the rule.

(5) The smaller and more immature fruits of the lowermost hands failed to ripen and developed a pasty discolouration and russetting which was quite comparable throughout. This effect is similar to that observed in the storage of immature Cavendish or Governor bunches.

While admittedly these observations should be repeated and confirmed on a larger scale, the general concensus of evidence undoubtedly lends support to Professor Cheesman's hypothesis that the several so-called varieties are identical. The further view that these tall varieties are closely allied to the Cavendish type is also borne out by such features as slow ripening of immature bunches, colour, and freckling on ripening, susceptibility to bruising and to *Gloeosporium* infection, and by the pasty and russet colouring developed by immature fruits in the ripening room.

In a second trial the following bunches, enumerated in Table 18, were held at 56° F. for 18 days and then transferred to the ripening room at 70° F.

TABLE 18

Label.	Variety.	Age of bunch in days.
A1	Masak Hijau	104
A2	"	105
3	"	106
B1	Lacatan	108
2	"	124
C	Martaban	100
D	Giant Fig	122

The Lacatan bunch (B 2) ripened after six days at 70° F., and the Giant Fig (D) after eight days. The Masak Hijau (A 1, 2, 3) bunches were quite yellow after 10 days; at this time the Lacatan (B 1) and Martaban (C) bunches were turning. Some irregularity in ripening was characteristic of the whole of this consignment, and even those bunches which were just "turning" on the tenth day at 70° F. showed occasional mature fruits. In addition to the similarities described in the first trial, which were again amply confirmed, it was noted that although an attractive yellow colour developed at maturity, all the varieties displayed a slight sootiness, particularly towards the finger-tips and on the lower sides which may be regarded as a very mild chill effect. Again a characteristic discolouration and dehydration effect induced in the slender finger-stalks was identical throughout.

In the light of the cumulative field and storage data available, based on bunches of approximately equal age grown under identical conditions, it may be accepted that there is no aspect of the evidence which can be regarded as contrary to Professor Cheesman's hypothesis. On the contrary, the ascertained facts lend strong support to the theory of identity.

VIII. MYCOLOGICAL OBSERVATIONS

General

As in previous storage trials, fungal wastage was of the usual type, being chiefly associated with mechanically injured tissues. Main-stalk rot was satisfactorily controlled by the application of vaseline to freshly cut stem ends and by rapid cooling. Tip-rots, caused by *Gloeosporium musarum* Cke. and Masee and *Botryodiplodia theobromae* Pat. were again in evidence as maturity was being reached. In the characteristic mechanical injuries (Fig. 5) which developed in finger-stalks of the Giant Governor, the subsequent rotting could be referred to *Glomerella cingulata* and *Fusarium sambucinum*.

For the first time during our storage trials in Trinidad, Pitting Disease, which is responsible for considerable wastage in Brazilian cargoes (4), has made its appearance on the Cavendish, Giant Governor and Gros Michel varieties (Figs. 5 and 6). This subject and the question of fruit spotting will be dealt with in greater detail in a later report.

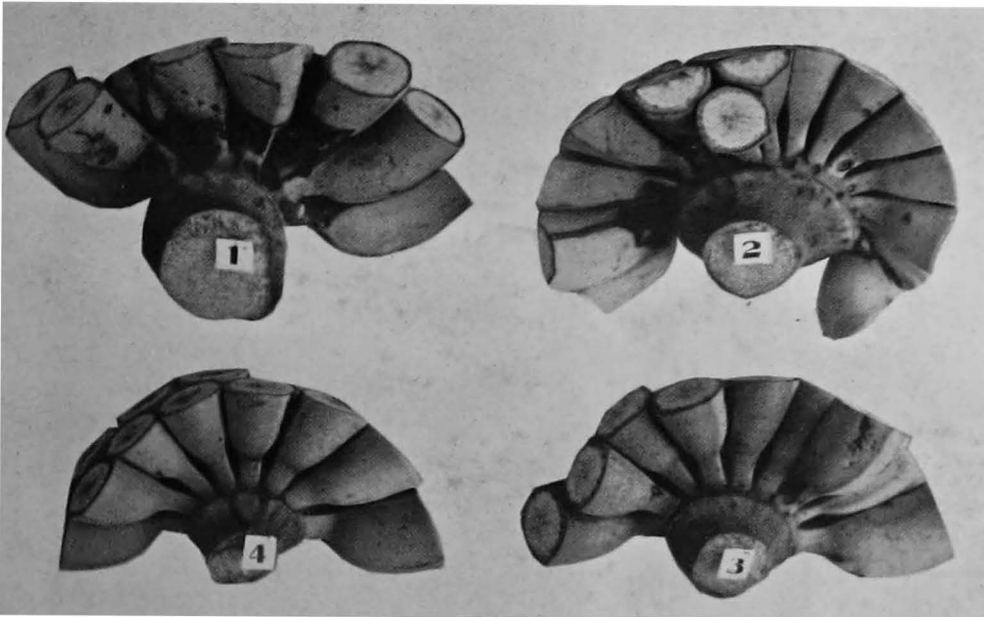


FIG. 6.—The four top hands of a bunch of Governor bananas illustrating the incidence of pitting disease.

IX. CONCLUSIONS AND RECOMMENDATIONS

1. The storage behaviour of the following varieties has been considered during recent investigations at the Low Temperature Station : Giant Governor, the Dwarf, Cavendish or Governor from various sources, Fillbasket, Gros Michel, the Hybrids I.C.1 and I.C.2, Giant Fig, Lacatan, Bumulan, Martaban and Masak Hijau.

2. The Giant Governor, believed to be a tall mutant of the Dwarf or Cavendish variety, in the course of four bulk storage trials has given promising results. When grown under similar conditions, this variety produces considerably larger bunches than the ordinary Dwarf or Governor variety, while the cylindrical shape and symmetry of the bunch and the relatively tough skin of individual fruits render it much more suitable for naked bulk transport. So far, the excessive injury to the top hands and general scarring usually found on the ordinary Governor have not been observed. Chill effects developed in fruit held at 53° F. for 16 or more days, but after cold storage at 58° F. normal ripening to an attractive deep yellow colour was the rule. A transport temperature commencing at 56° F. and rising to 58° F. would probably be suitable for this variety. Bunches must be reaped at a stage corresponding to " heavy $\frac{3}{4}$ -full " in the Gros Michel otherwise ripening at 70° F. is greatly delayed, and abnormal colour effects, such as pastiness or russetting, develop. As a result, fruit for export tends to be heavy and the individual fingers of rather large size. Texture and flavour are good. Shipping trials, conducted under the usual commercial conditions at a temperature of 56° F.-58° F. are necessary before a definitive opinion can be offered.

3. The Cavendish or Governor variety when grown on relatively poor soil with the help of fertilisers showed a very marked response to the manurial treatment. The bunches, however, proved very subject to mechanical injury, damage to finger-stalks, bruising and scarring being excessive even after a very short careful haulage. Such fruit would be quite unsuitable for export.

4. Judged by their bunch habit, colouring, texture, flavour, etc., Dwarf Cavendish from various sources, British Guiana, Trinidad, Barbados, Virgin Islands and Canary Islands, etc., seem to be very closely related if not one and the same variety.

5. Bunches of Fillbasket held at 53° F. for 16 days subsequently ripened very attractively at 70° F. While its bunch habit and thin skin preclude rough treatment, it is thought that it might possess some local commercial value.

6. In two bulk storage trials with the Gros Michel, wastage due to breaking of finger-stalks, scarring and bruising was quite normal and comparable with that experienced in Jamaican or Central American fruit. Uneven ripening in bunches, where single fingers or entire hands were involved, was a characteristic feature of both trials. As this would be regarded as a serious defect by the Trade, further investigations to determine whether it is cultural or seasonal, are required.

7. In a preliminary storage trial with the new College Hybrid I.C.2, it was found that this variety possesses characters common to the Gros Michel, namely resistance to bruising and attractive yellow colour on ripening. The flesh is of good texture, and is regarded as being superior in flavour to the Hybrid I.C.1. The bunches so far obtained—on relatively poor soil—have been small and the fingers short, thick and closely packed. Further storage trials are required with well developed bunches grown on good alluvial soil.

8. Bunches of Giant Fig, Lacatan, Bumulan, Martaban and Masak Hijau, of approximately the same age and obtained from the same or adjacent rows in the College variety plot, were stored and ripened under identical conditions. All showed very great similarity in the characters developed during ripening. This lends support to a view which has been expressed that these several tall forms are not separate and distinct varieties, but are, in fact, identical.

9. Pitting disease, which is responsible for considerable wastage in Brazilian cargoes, was in evidence during these trials on the Giant Governor and Governor varieties. A very mild and economically unimportant form of this disease was also observed on the Gros Michel.

In conclusion the writers desire to acknowledge the assistance they have received in carrying out this work. To the Trinidad Department of Agriculture, Mr. G. F. Huggins, O.B.E., Mr. R. Huggins, Woodford Lodge Estates, Ltd., and the College Departments of Agriculture and Botany they are indebted for supplies of fruit, and they again avail themselves of the opportunity of expressing their thanks to the Principal and Members of the Staff for their helpful co-operation.

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