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THE ELECTRICAL INDUSTRY OF GREAT BRITAIN

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THE ELECTRICAL INDUSTRY OF GREAT BRITAIN:
ORGANIZATION, EFFICIENCY IN PRODUCTION
AND WORLD COMPETITIVE POSITION

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INTRODUCTION—THE PURPOSE AND SIGNIFICANCE OF THE MONOGRAPH

IN spite of the fact that the electrical industries have assumed a new and increasing importance in the economic configuration of the country, no survey has yet appeared which would allow one to estimate the present strength of the industry and define its position among those economic developments which are slowly but surely determining the balance of economic power in the world. One might assume that it is not the function of a trade association to carry out such a survey, since it lies almost wholly within the sphere of academic research, and certain critics have definitely stated that a trade association by its very nature should not be expected to carry out such work.

In the case of the electrical industry, however, the situation is quite different. There is no body of transmitted thought; there is practically no historical background. Very little of the apparatus, the information, and the vested experience which is available in the case of the older industries, already in active operation for more than a hundred years, can be utilized for the purpose of investigating the economic potentialities and the competitive efficiency of electrical engineering. The industry is peculiar in this sense, that it is changing more rapidly than almost any other industry. It is developing new sources of demand, expanding production, deepening technical knowledge, and widening technical capacity. The growth of invention is so rapid in it that the manufacturer is always confronted with the necessity for immediate adjustment. The result has been that even now, after almost fifty years' commercial activity, the industry remains in a fluid state, and the industrialist active in it knows that he is contributing in no small measure to the realization of new economic values and, ultimately, to the elaboration of a new industrial civilization. He knows instinctively that this is true, but at present he has no direct criteria. He has few standards other than those of immediate experience, and the lack of those standards may affect the scientific evolution of the industry.

The justification, therefore, of the survey carried out by this Association lies in three things, each of them fairly important:

(1) It gives a considered opinion or, rather, it places at the disposal of the public the experience and the special knowledge which have been governing factors in the work of adjustment within the industry to changing economic conditions.

(2) Through the very act of definition necessary to the preparation of such a survey, the industry

PURPOSE AND SIGNIFICANCE OF THE MONOGRAPH

itself becomes cognizant of significant influences which, together, define competitive efficiency and render possible the assessment of potentialities and expansion. For guesswork based purely on empirical knowledge one may substitute a reasoned and statistically developed argument, and even if the opinion of the individual industrialist does not coincide with the details of the argument put forward, the very act of thinking along definite lines is of value for the comprehension of economic motive and economic strength within the industry.

(3) A survey of the nature projected justifies itself above all through the exact arrangement of essential information and essential statistics which it gives, provided, of course, as in this publication, it aims at impartiality and accuracy and truth of perspective.

The industry is placed in possession of national and international statistics which are sufficient to abolish to a considerable degree uncertainty and to introduce a feeling of reality and a sense of concrete values. The importance of this alone to an executive who has to plan ahead for a number of years and bring his productive capacity into line with market requirements, is obvious. He can apply his own expert knowledge to the assessment of the movements described in the survey and derive his own conclusions. The very fact that he is placed in this position is of value for the growth of rational production.

Again, the electrical industry in its organization has been subject to ill-informed and, from many points of view, malicious criticism, to a greater extent than almost any other phase of the national economic configuration. A number of vague accusations, based on ignorance of essentials, has had influence on public opinion at certain times, even although the impression is general that the industry is one of the most important assets the nation possesses. The only method of dispelling such an atmosphere and of countering such criticisms is to supply information to the public sufficient to allow it to form its own opinion without the need for special interpretation.

In this monograph the main objects kept in view have been impartiality and objectivity of statement, adherence to truth, both in perspective and in manner of expression. There has been no attempt, for example, to cover up significant movements with diplomatic half-truths. The facts are clear and are presented with as little comment as possible. Certain deductions have been drawn from these facts; the reader can decide whether these deductions are justified or not. The industry is not concerned in establishing or in maintaining a purely privileged position. Its history, during the last ten years especially, renders this unnecessary. The monograph represents a definite contribution to economic knowledge, where special interests have not been allowed to intervene, and it should be considered from this point of view only.

For obvious reasons three sections may be distinguished :

PURPOSE AND SIGNIFICANCE OF THE MONOGRAPH

(1) Electrical manufacture, with its various economic sub-divisions, such as capitalization, earning capacity, competitive efficiency, prices and wages; with less obvious factors such as rationalization and amalgamation and national political and economic policy, such as that represented by taxation, fiscal legislation, and Reparations. A further section of electrical manufacture of very great importance is, of course, that represented by export trade and, in this case, we have made a definite international comparison in the most minute detail over the two years, 1927-1928, the only years during which international statistics were sufficiently comparable to permit of exact assessment and comparison.

(2) The second main section lies in the demand for electrical equipment, and this brings us into electricity supply and the possibilities of carrying out national electrification according to the Supply Act of 1926. An important part of the investigation bears on power potentialities and the limits of economic expansion.

(3) In an intermediate position between electrical manufacture and electricity supply comes power finance, which is in essentials the application of financial facilities and the diversion of new capital savings into schemes which will utilize power resources, create a demand for electrical equipment, on the one hand, and cause expansion of electricity supply on the other. This third section is of importance from the point of view of international competition: it is playing every year an increasingly important part in the allocation of large contracts.

The survey has not followed in exact sequence such a distinction, but it is implicit in plan and presentation, while a concluding section summarizes what are the main factors deciding the economic alignment of the industry both on the manufacturing and power supply sides, and suggests what position the power industries will take in the economic future of the country. In a series of appendices are given statistics supplementary to those contained in the text, as well as two reports on Dominion trade and the Canadian market.

It should be remembered that this survey is largely tentative; it has no claims to finality or even to what may be regarded as economic rectitude, for the simple reason that economic science, as defined in our present class-books, only applies very partially to the electrical industry, and it is necessary to evolve a new phase or branch of this science which will include the industry without throwing it entirely out of phase. The monograph suggests how the power industries of this country may be effectively developed, and if it is successful in encouraging that development along the lines laid down, it will have justified itself. It is now generally recognized that a vital necessity for this country lies in the fullest possible expansion of electrification, especially in manufacturing processes, and any investigation that can throw light on the methods which should be adopted to accelerate such electrification must have considerable value.

Certain sections of this survey have appeared in *World Power*—namely, Appendices A and B, dealing with Canada as an example of Imperial Preference and the Dominions as markets for British electrical goods, and the fourth section

PURPOSE AND SIGNIFICANCE OF THE MONOGRAPH

of Chapter IV., giving an international power survey; while the fifth section of the same chapter appeared originally in the *Financial Times*. Modifications have been introduced to some extent in all of these passages as printed in this book and the statistics have been brought up-to-date.

After careful consideration it was decided not to include an index, since the book does not lend itself easily to indexing. To make good this omission we have included a very extended list of contents and of statistical tables, while the page headings give an indication of the subject matter sufficient to make the work of consultation comparatively easy. The statistics have been verified as carefully as possible, but it should be noted that the export trade returns as furnished for 1928 by the Department of Customs and Excise are provisional and may be subject to correction.

CONTENTS

	PAGE
INTRODUCTION: THE PURPOSE AND SIGNIFICANCE OF THE MONOGRAPH	v
CHAPTER I—THE ECONOMIC CONFIGURATION OF THE INDUSTRY.	3
<p>Main groups in electrical manufacture—capital goods and consumption goods—effect of capital turnover in electricity supply—tendency towards large installations—neutralizing fluctuations in demand—disadvantages to the manufacturer in recent movements—value of contracts—significance of quality production—flow of capital into the industry—trustification and co-operation—production of consumption goods—standardized output—change in balance between generation and distribution equipment—power finance and its definition—types of power finance concerns—the work of issuing houses and investment trusts—finance and international co-operation—economic factors in electricity supply—price policy and capital expenditure—the optimum return on investment—demand and its dependence on economic price—load-building—co-operation between electricity supply and electrical manufacture.</p>	
CHAPTER II—ELECTRICAL MANUFACTURE: MANUFACTURING, FINANCIAL, COMPETITIVE AND LABOUR CONDITIONS	21
<p>(I) PRODUCTION. Production in Great Britain and U.S.A.—comparison between 1907 and 1924—development from 1920 to 1928—main branches of manufacture—productive capacity—post-war cycles of prosperity and depression—national consumption of electrical products—export percentages—meeting home demand—effect of falling prices—improvement in competitive position—balance of the industry.</p>	
<p>(II) PRICES AND COSTS. Main items in costs—real significance of materials—part played by labour—factory and commercial expenses—taxation—costs in 1912 and 1927—cost increases in main branches—control over costs—tonnage versus capacity—labour efficiency—excess labour charge—rationalization in equipment—changes in manufacturing practice—higher power per unit of weight—economies in materials and design—increased efficiency of generating plant—fuel consumption in British power stations—advances from 1922–23 to 1928–29—superiority of British practice—import and export prices—course of prices since 1920—capital cost of generating plant—conclusions.</p>	
<p>(III) INTERNATIONAL COMPETITIVE EFFICIENCY. Costs of materials—international rates of wages—course of wages in Great Britain and Germany—Switzerland, France and Belgium—international comparison—hours of labour in leading countries—national and local taxation—international production costs in 1913 and 1928—British disadvantages—basis of competitive strength—changes in power plant practice—research and development—creation of goodwill.</p>	

CONTENTS

	PAGE
(IV) CAPITALIZATION AND EARNING CAPACITY. Financial position of leading firms—return on total capital—low appropriation to reserves—excessively narrow margins—need for stable prices—subnormal and delayed demand—capital turnover—net yield on output—capitalization and earning assets—improvement since 1913—emergence of composite firm—specialist firms—difficulty of access for new firms—co-operation and the “ring” complex—an international movement—purpose of chapter.	
CHAPTER III—EXPORT TRADE: WORLD COMPETITIVE POSITION	
(I) THE SIGNIFICANCE OF EXPORTS. Economic factors governing export trade—productive capacity and consumption—export and import prices—manufacturing load—the effect of specifications—national balance of payments—export of capital—importance of British technical and scientific enterprise—post-war difficulties—American entrance into international finance—industrial significance of electrical exports—growth of world export trade.	67
(II) THE EXPANSION OF BRITISH ELECTRICAL EXPORTS. Pre-war export movements—machinery developments—detailed exports from 1920–1928—change in balance of shipments—not a picture of uniform advance—factors in favour of Great Britain—technique and finance—value of Dominion market—growth of leading markets, 1903–19 and 1920–28—Australia, New Zealand, and Canada—South America and Asia—Europe—industrial expansion of Dominions—Indian cycles of activity—South Africa—Canada—Argentina, Brazil, Chile—China and Japan—Europe.	
(III) INTERNATIONAL ELECTRICAL EXPORT TRADE. Exports from six countries—exports from five countries to Dominions and Colonies, North America, Central and South America, Asia, Africa, Europe, and Great Britain—competitive strength of Great Britain in the world market—European recovery—American financial penetration and German Reparations in kind—value of principal markets in 1927 and 1928 and the British proportion—British penetration into Europe.	
(IV) BRITISH AND AMERICAN COMPETITION. British and American exports to ten markets—pre-war and post-war changes—recovering lost markets—South America—Japan—Canada—growth of Australian imports—weight of American competition.	
(V) REPARATIONS. The influence of Reparations on German industry—danger to British industrial prosperity—the Reparations weapon—the real significance of Reparations deliveries—a premium on German exports—the German forward move in exports—examples of a vicious system—a threat to British firms—provisions of the Young Plan—danger of new proposals—an abortive policy.	
(VI) POWER FINANCE. Industrial financing by banks—international power finance groups—methods of financial penetration.	
(VII) SUMMARY. Exports as a percentage of total output in main competing countries—declining price levels and profit margins—end of a process—new period of adjustment—American prices—growth of European and Dominion markets—an opportunity for the British electrical industry.	

CONTENTS

	PAGE
CHAPTER IV—ORGANIZATION AND GROWTH OF THE HOME MARKET	115
<p>(I) THE SIGNIFICANCE OF THE HOME MARKET. Importance of the power industries—world expenditure on electricity supply—financing export trade—the function of the electrical manufacturer in stimulating home demand—national importance of the industry.</p>	
<p>(II) THE GROWTH OF ELECTRICITY SUPPLY. Expansion from 1907 to 1924—post-war acceleration—primary plant capacity and power production—modernization of British industry—generation of electricity from all sources—comparison with U.S.A.—public versus private supply—a movement of conversion—electricity supply in Germany—annual capital expenditure.</p>	
<p>(I II) THE INDUSTRIAL DEMAND. Electrification of manufacturing processes—U. S.A., Great Britain, Germany—subnormal state of industrial consumption in Great Britain—the shortage of electric motors—the maximum electrification of industry in Great Britain.</p>	
<p>(IV) INTERNATIONAL POWER SURVEY. Main factors governing economic development—use of natural resources—prime-mover capacity, electrical power plant capacity, industrial electric motors, production of electricity, industrial and electrical position, optimum electrical output in ten leading countries—economic changes in competing countries—mechanization of production—world output of electricity and capacity of generating plant—optimum expansion.</p>	
<p>(V) THE POTENTIAL POWER MARKET. The limits of expansion—modifying elements in calculation—general prosperity or depression, price conditions, technical adjustments, the significance of competition between industries—distribution of power consumption—estimating future demand by industry, commerce, domestic consumer, agriculture, and traction—limits of production during next twelve years—the Weir Report—effect of the national scheme—electrical output in 1941.</p>	
 CHAPTER V—THE REORGANIZATION OF ELECTRICITY SUPPLY	 147
<p>(I) THE BACKGROUND. Rationalization of electricity supply—the stimulation of demand.</p>	
<p>(II) THE WORK OF THE SUPPLY UNDERTAKING. The science of power demand—lack of statistical data prior to 1920—the need for exact surveys—difficulties confronting the supply undertaking—consciousness of a national background and a national entity—capital value of central station efficiency—average prices for electricity, 1921–22 to 1926–27—progress in leading municipalities and companies.</p>	
<p>(III) THE STIMULATION OF DEMAND. Need to create an atmosphere favourable to electricity—work of electrical development associations—local penetration or a sweeping national campaign—policy of manufacturers.</p>	

CONTENTS

	PAGE
(IV) THE WORK OF THE ELECTRICITY COMMISSION. Post-war co-ordination plans—difficult problem—simplification of types of organization, definition of power zones and interconnection of power zones—compulsion or co-operation—production and distribution—progress in Germany and Italy—difficulties confronting formation of large supply company—importance of municipalities—methods adopted by the Electricity Commission—determination of Electricity Districts—findings of the Weir Committee—advocacy of Central Electricity Board.	
(V) THE NATIONAL POWER SCHEME. Seven super-power zones—capacity of generating units—preference for less spectacular capacities—new capital stations—functions of Central Electricity Board and their justification—the price of electricity—expenditure of Central Electricity Board on transmission and standardization of frequency—extension of generating stations—the power market in Great Britain.	
 CHAPTER VI—THE ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION	167
(I) ELECTRICAL POWER CONSUMPTION. Electricity as an economic indicator—industry, area of greatest potential demand—grouping of firms—basic industries and trade depression—electrification and capital expenditure—importance of rationalization—recovery of industrial demand—smaller industries—regional surveys—exploiting surplus power possibilities of the coal-mining and metallurgical industries—main line electrification—water-power versus steam-power stations—world comparisons—suburban line electrification—electric drive in ships—reorganization of transport facilities—agricultural and rural electrification—potential demand—revival of rural craftsmanship—industrialization of agriculture—Italian enterprise—domestic consumption of electricity—commercial developments—national organization based on electrical power.	
(II) ELECTRICAL MANUFACTURING EXPANSION. Efficiency and credit status—place in national economy—relation to other industries—export trade and export of capital—real significance of new capital issues—premium on foreign competition—security instead of encouragement of enterprise—power finance and its opportunities—State assistance to power finance—Trade Facilities Act—need for research and development—acceleration of orders in connection with national scheme—essentials of a national power policy.	
 CHAPTER VII—ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES	191
Industry a living body—logically perfect schemes no cure in themselves for depression—influence of national financial, fiscal, and social policy—background of economic fact—essential unity of industry—the trust—economic research—effect of credit restriction—limit to large concerns—the national electricity scheme and the power trust—the new interpretation of competition—foreign and home prices—competition between industries—world significance of the power industries—decentralization of production—work of the Central Electricity Board—capital and earning value of electricity supply and electrical manufacture—super-power and national prosperity.	

CONTENTS

	PAGE
APPENDIX A: POWER FINANCE AND IMPERIAL PRE- FERENCE. THE EXAMPLE OF CANADA	205
APPENDIX B: INTERNATIONAL ELECTRICAL EXPORTS	219
APPENDIX C: THE DOMINIONS AS MARKETS FOR BRITISH ELECTRICAL PRODUCTS	221

STATISTICAL TABLES

TABLE

I Capital Invested in Electricity Supply and in Electrical Manufacture in Great Britain (1903-28)	9
II Production of Electrical Machinery and Apparatus in Great Britain (1924) and U.S.A. (1925)	22
III Production of Electrical Machinery and Apparatus in Great Britain and U.S.A. (1907)	22
IV Production of Electrical and Allied Machinery and Apparatus in Great Britain (1913, 1920-28)	23
V Production and Consumption of Electrical and Allied Machinery and Apparatus in Great Britain (1913, 1920-27)	26
VI Distribution of Costs of Production (1913 and 1927)	30
VII Increase in Costs of Production (1913 and 1927)	32
VIII Labour Efficiency in Electrical Plant Production (1913-27)	33
IX Fuel Consumption per unit Generated in Central Stations (1920-28)	38
X Power Station Efficiency in Great Britain (1922-23-1928-29)	38
XI Total Saving in Fuel through Higher Overall Thermal Efficiency of Stations in Great Britain (on 1921-22 basis)	38
XII Power Station Efficiency in Great Britain (Twenty-five most Efficient British Stations)	39
XIII Import and Export Prices of Electrical Machinery (1904-29)	42
XIV Index of Prices of Electrical and Allied Products (1920-28)	43
XV Capital Expenditure on Electrical Plant and Machinery (1923-1927)	44
XVI Average Wages paid in Electrical and Allied Engineering in Great Britain (1914-28)	47
XVII Average Wages paid in Electrical Engineering in Germany (October 1928)	47
XVIII Average Wages paid in Engineering Industry in Switzerland (1913 and 1928)	48
XIX Average Wages paid in Electrical Engineering in France (1924-28)	48
XX Average Wages paid in Engineering Industry in Belgium (1928)	49
XXI International Comparison of Wages in Electrical Industry (1913 and 1928)	49

STATISTICAL TABLES

TABLE	PAGE
XXII Hours of Labour : Actual Working Hours in Metal Working and Engineering	51
XXIII Taxation (National and Local) in 1913 and 1927	52
XXIV International Comparison of Costs of Production (1913 and 1928)	53
XXV Financial Position of Electrical Plant Manufacturers (1925-28)	57
XXVI Exports of Electrical Machinery and Apparatus from Great Britain (1903-28)	74
XXVII Electrical Exports of Great Britain (1920-28)	76
XXVIII Exports of Electrical Machinery and Apparatus from Great Britain to Principal Markets (1903-19)	79
XXIX Exports of Electrical Machinery and Apparatus from Great Britain to Principal Markets (1920-28)	80
XXX Exports of Electrical Machinery and Apparatus from Five Countries (1913, 1924-28)	85
XXXI Electrical Exports from Six Countries (1927 and 1928)	85
XXXII Electrical Exports from Five Countries to British Dominions and Colonies (1927 and 1928)	86
XXXIII Electrical Exports from Five Countries to U.S.A. (1927 and 1928)	86
XXXIV Electrical Exports from Five Countries to South and Central America (1927 and 1928)	86
XXXV Electrical Exports from Five Countries to Asia (1927 and 1928)	87
XXXVI Electrical Exports from Five Countries to Africa (1927 and 1928)	87
XXXVII Electrical Exports from Five Countries to Europe (1927 and 1928)	87
XXXVIII Electrical Exports from Four Countries to Great Britain (1927 and 1928)	88
XXXIX International Trade in Electrical Machinery and Apparatus (1927 and 1928)	93
XL Exports of Electrical Machinery and Apparatus from Great Britain and U.S.A. to Leading Markets (1908-28)	94
XLI Imports of Electrical Machinery and Apparatus into Australia (1912-28)	98
XLII Growth of Generating Resources (1907-24)	118
XLIII Growth of Prime-Mover Capacity (1907-24)	119
XLIV Analysis of Generating Plant Installed (1907-24)	119
XLV Electrical Plant Capacity and Output in Great Britain (1920-28)	121
XLVI Total Capacity and Output of Public Supply Stations in U.S.A. (1912-28)	121
XLVII Total Generating Plant Capacity in U.S.A. (1914-27)	122
XLVIII Total Capacity of Primary Power Plant in Great Britain (1924-28)	122
XLIX Electricity Supply in Germany (1925-28)	124
L Industrial Electrification in Great Britain, U.S.A., and Germany	126
LI Amount of Total Factory Power in America applied through Electric Motors (1899-1927)	127
LII Deficiency of Electric Motors in British Industry	129
LIII International Power Survey : Prime-Mover Capacity	131

STATISTICAL TABLES

TABLE	PAGE
LV International Power Survey: Electrical Power Plant Capacity	131
LV International Power Survey: Electric Motors Installed in Industry	132
LVI International Power Survey: Production of Electricity from all Sources	132
LVII International Power Survey: Industrial and Electrical Development	132
LVIII International Power Survey: Optimum Electrical Development	133
LIX International Power Survey: Optimum Electrical Production	133
LX Distribution of Power Consumption in Great Britain (1920-27)	139
LXI Total Potential Power Production in Great Britain	141
LXII The Price of Electricity in Great Britain (1921-26)	151
LXIII Electricity Supply in Great Britain (1921-22 and 1928-29)	151
LXIV Capacity of Generating Plant in Great Britain (Extensions, 1928-41)	160
LXV Capital Expenditure on Generating Plant and Machinery (1929-41)	163
LXVI The Power Market in Great Britain (1929-41)	164
LXVII Foreign Capital Issues in London (1925-29)	183

STATISTICS IN TEXT

Steam-Turbine Development in U.S.A. (1918-28)	37
Use of Pulverized Coal in U.S.A.	55
Prices of American Electrical Machinery Products	109
Distribution of Electrical Power Production in 1923-24	140
Expenditure by Central Electricity Board in Six Areas	162

STATISTICS IN APPENDICES

APPENDIX A

I Production and Consumption of Electrical Machinery and Apparatus in Canada (1920-28)	207
II Electricity Supply in Canada	209
III Electricity Supply in Canada—American-Controlled Companies (Capitalization)	211
IV Electricity Supply in Canada—Holt-Gundy and Allied Groups (Capitalization)	212
V Electricity Supply in Canada—Nesbitt-Thomson and Allied Groups (Capitalization)	213
VI Electricity Supply in Canada—Independent Companies (Capitalization)	214
VII Electricity Supply in Canada—American-Controlled Companies (Generating Plant Capacity and Output)	215
VIII Electricity Supply in Canada—Holt-Gundy and Allied Groups (Generating Plant Capacity and Output)	216

STATISTICAL TABLES

TABLE	PAGE
IX Electricity Supply in Canada—Nesbitt-Thomson and Allied Groups (Generating Plant Capacity and Output)	216
X Electricity Supply in Canada—Independent Companies (Generating Plant Capacity and Output)	217
XI Electricity Supply in Canada—Municipalities	217

APPENDIX B

I Electrical Exports from Six Countries, 1927 and 1928	<i>Facing page</i> 220
II Market Distribution of Electrical Exports, 1927	,, 220
III Market Distribution of Electrical Exports, 1928	,, 220

APPENDIX C

I Export Demand for Electrical Products	224
II Imports of Electrical Machinery and Apparatus by Five Dominions	225
Diagrams and Charts illustrating the Growth of Dominion Electrical Trade	231

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

CHAPTER I—THE ECONOMIC CONFIGURATION OF THE INDUSTRY

IN every comparatively new industry a period of adjustment and of internal change takes place before something like a state of balance ensues and one can define with a fair degree of accuracy the main elements within its composition and the influence of such elements on each other. It is too soon to carry out such a definition in the case of the electrical industry, but certain movements may be distinguished even now.

Electrical manufacture falls naturally into two main groups :

- (1) The heavy plant and equipment group, producing capital goods ;
- (2) The mass-production group, which is engaged almost exclusively in turning out consumption goods.

Within these two main groups must be distinguished, of course, less important groups which have not yet clearly emerged and cannot, therefore, be accurately described. They would cover the activities of special firms which are engaged in supplying auxiliary plant and equipment required by the firms within the first group, as well as firms producing an extremely intricate and highly scientific product which might be ranged almost within the lines of a new industry. This observation applies above all to the manufacture of scientific instruments and electro-medical apparatus. If one adheres, however, to the broad distinction between capital and consumption in an examination of the configuration of the industry, one can establish certain principles of value. We may approach the first group by way of the electricity supply industry, since the latter constitutes the main source of demand for its products.

The electricity supply industry is distinguished by a very slow rate of capital turnover—in other words, a very heavy outlay on generating plant and transmission and distribution systems must be incurred to obtain a comparatively low earning capacity as measured in capital values. Thus, in a modern power system, the gross earnings in any year may not be more than 19 per cent of the total capital invested. On the other hand, the main installations represented by this capital are of such a nature that they require a comparatively low rate of depreciation each year. They are primarily subject to obsolescence inasmuch as technical progress in the industry may be such that it would be more profitable to install new equipment, and increase capital expenditure by this amount, than to retain old equipment and avoid such

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

expenditure. This consideration is of some importance when the economic position of the first group of electrical manufacture is considered.

This group is engaged in the manufacture of heavy generating plant, such as turbo-alternators, condensers, transformers, switchgear, rotary converters, and other apparatus used in a modern power station and main transmission system. It may also cover the manufacture of main transmission lines and cables. This group, therefore, meets all the requirements of the electricity supply industry, from the distribution sub-station, where electricity is supplied to the consumer, up to the power plant itself. In addition to this, it is specially active in meeting the requirements of industry generally, and especially of those industries which, like coal-mining and iron and steel, demand a very high power capacity per unit of output. In this case, it may supply generating plant equipment for industrial uses and even branch out into a number of allied products such as steam-turbines, turbo-blowers, turbo-compressors, and other mechanical power installations. It covers also the production of large dynamos and motors from 100 H.P. up to 25,000 H.P. peak capacity. It may carry out, for example, the electrification of an entire factory or even, in some cases, of an entire industry if this industry is concentrated in a small number of producers. It can also undertake an entire railway electrification scheme, from the rolling stock up to the electrification of the line itself, the equipment of sub-stations and the provision of generating stations feeding into the railway system. It is possible to enumerate other sections in which this group can be active, but we have indicated the most important.

Of these three sections—namely, electricity supply, industry, and electric traction—electricity supply is distinctly the most important, and the economic development of electrical manufacture in this respect at least has been affected by conditions in the electricity supply industry. We have indicated already certain fundamental characteristics of the latter, namely: the slow rate of capital turnover and the low percentage of capital depreciation required owing to the nature of the installation. To those may be added the extremely complicated nature of the system of power generation, transmission, and distribution.

The effect of the low rate of capital turnover in electricity supply is to place emphasis on the capital installation itself. It must be of a particularly high quality; it must be as efficient as modern practice allows; and it must be carried out according to exact and, in many cases, rigid specifications to ensure that it will fit into the power supply system without excessive waste either of material or energy. This has meant that the electrical manufacturing firms supplying this type of equipment have been forced to concentrate on activities which, at first sight, would appear to con-

EFFECT OF SUPPLY INDUSTRIES' CAPITALIZATION

stitute an extra burden on production. These activities bear specially on research and development—research into materials and processes and new production methods which will ensure rapid adaptation on the part of the manufacturing shops to changes in technique and to the exact demands which arise from the expansion of electricity supply. Development is concerned more with the exact investigation of manufacturing processes, the careful testing of plant and equipment already evolved either in the research or designing offices, and it involves, as a consequence, very heavy expenditure on new equipment which may be introduced into the power market with a view to increasing efficiency and accelerating the rate of obsolescence already established in electricity supply. Again, the slow rate of capital depreciation in electricity supply means that renewals and replacements do not constitute an important factor as such in the market for power equipment. The industry is dependent, therefore, on extensions and on new installations and, above all, on its capacity to produce new types of plant sufficiently economical in operation to justify plant retiral before it is normally due, in favour of this new installation.

Progress in heavy plant production has been affected by three factors arising out of the considerations already given :

- (1) The provision of special resources of an immediately non-productive nature to ensure adequate research and development ;
- (2) The necessity to finance very large contracts and to meet in the manufacturing shops themselves the increasing demand for expensive machine tools and other productive apparatus ;
- (3) The limitation imposed on competition by economic changes.

Owing to a general tendency within public utilities, not only in this country but abroad, to widen their activities and become larger consolidations, the movement towards development of large units in the electricity supply industry has become pronounced. The argument as it has been elaborated in the United States, is that only large power plants and power systems supplying wide territories can effect the greatest economies and the greatest earning capacity per unit of capital expenditure. The tendency has been, therefore, for large power plants and power systems to increase steadily from year to year. In addition to this, the earning capacity of the individual units themselves requires constant supervision. There is also a perpetual effort made to cut down the costs of production, and these costs of production are influenced directly by the ratio of loss, first of all, between the potential energy fed, in the form of coal or even of water-power, into the generating plants and the energy which is fed into the transmission system, and between the energy generated and fed into the system and the energy which goes into consumption. Research has been concentrated, above all, on reduction in fuel and other costs in the generating station, partly through the use of

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

cheaper types of fuel wherever possible, but mostly through reduction in the losses which occur in the generation of electricity. The demand has been, therefore, for plant of very high efficiency, since a very small increase in the latter may have a very high capital value as measured in terms of the entire system.

The second development is based on the realization of a higher earning capacity in the transmission and distribution systems. Such a realization depends, above all, on the capacity of the distribution system to maintain a steady demand on the generating plant, so that every section of the elaborate arrangement which links up the turbo-generator with the consumers' apparatus will be kept continuously in operation, with the minimum waste of time and of energy. Economy in this direction has borne on transmission and distribution equipment, such as transformers, cables, and overhead transmission lines. It has also borne on the generating plants themselves, owing to the fact that these plants are required to meet very rapid changes in load. The only possible method of cutting down such reserve plant to a minimum is to neutralize fluctuations through the widest possible spread of demand.

The influence of these changes on the position and prospects of the plant manufacturer has in the past few years been very great. Thus turbo-alternators, which at one time reached a capacity of 10,000 KW., have now increased in capacity to 60,000 KW. and even 80,000 KW. in a single unit, but the cost of such a unit (measured per kilowatt) has decreased with increased unit capacity. Thus one 80,000 KW. set costs considerably less than eight sets of 10,000 KW. each. The manufacturer suffers, therefore, from two main disadvantages. First, he must incur very heavy initial capital expenditure on materials and on processes and on the design data which are required for the very large units. Secondly, he must be content with a smaller surplus on the very large unit than on the aggregate of all surpluses from smaller units, which together would equal the larger units in capacity. In other words, the manufacturer of the eight 10,000 KW. units would incur the greater part of his preliminary development and test expenditure on the first unit and economize progressively from the second onwards. His margin of profit would increase as the movement towards standard production became accelerated. The case could, therefore, be established where the electrical manufacturing industry would enjoy, in certain cases, a higher profit margin through the provision of smaller units than through the provision of large.

Again, the effect of competition must be considered, especially where the consumer is very powerful, as in the case of supply undertakings in this country. In certain cases, it may be found that the very large unit, instead of bringing in a margin of profit, might easily involve a heavy loss. Production becomes speculative

EFFECT OF LARGE INSTALLATIONS ON CONTRACTS

to some extent, inasmuch as the values and outputs involve a greater initial outlay, and the possibilities of a weakness either in materials or design having very serious results measured in terms of capital must always be guarded against. Production ceases to be standardized, even in the smaller accessories and parts built into the finished unit, since these accessories and parts are affected by the increase in capacity and the additional stresses placed as a consequence on them. The economies to be effected in the workshop through mass-production tend to disappear.

As a result of this tendency towards large units and large power systems, the value of contracts has increased very rapidly. Even a few years ago, a contract amounting to £40,000-£50,000 was regarded as a very large contract indeed, but now it may easily exceed £500,000 or, where a main contract is let for an entire installation, £1,000,000. Such a contract, which usually covers two or three years, requires to be financed, quite apart from all questions bearing on manufacturing capacity, and financial operations of the scale required to handle it are only possible in the case of a limited number of firms. Those firms, if they have been able to accumulate sufficient liquid resources, may be able to carry out a contract of this nature with ease without assistance from an outside source, but the multiplication of large contracts renders it ultimately necessary for the manufacturing firm either to secure accommodation from financial institutions or to create itself a special financial and development company. Such a development makes it difficult for a new firm to enter the industry on the heavy generating plant side. It also adds significance to the technical strength of the industry. Thus new machine tools of the largest size must be installed to deal with such contracts, and the necessity for this, in common with other adjustments of a similar nature, adds undoubtedly to the efficiency of the industry and increases its competitive ability both at home and abroad. The nature of the market itself and its requirements is sufficient to ensure a steady improvement in manufacturing technique, without the necessity for the power contracts at home to be thrown open to indiscriminate international competition.

As far as the heavy sections of the electrical industry are concerned, there is no incentive (other than those already active) required to improve efficiency and rationalize production, and the general theory that competition is beneficial in this respect has little validity in comparison with the experience that the necessity to meet requirements of an ever-changing industry provides in itself the very strongest possible motive for scientifically regulated production. This section of the electrical industry has been built upon quality production and not on mass-production at a minimum price. It has already been proved that the capital value of such efficiency combined with reliability and steady operation may increase the earning capacity of

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

supply undertakings to such a point that a very considerable increase in capital expenditure on initial equipment can be undertaken. Direct price comparisons can only be misleading where no exact computations are available to allow for other factors entering into consideration. The economics of heavy electrical plant engineering are not to be found in price considerations alone, but in the relations between capital costs, earning capacity, depreciation, and obsolescence.

It is definitely established that the movement towards very large units and very large inclusive contracts will accelerate in the future rather than decline, and arising out of this movement comes the question of limitation of competition. Certain theorists who have been accustomed to deal with industries manufacturing commodities in general use, such as coal, iron and steel, or agriculture, have held that, where an industry shows a high profit-earning capacity, which is generally associated with a fairly close adjustment between productive capacity and actual output, and even, in some cases, with a definite shortage of productive capacity, employment and capital move naturally towards them. In other words, if the capital invested in electrical engineering is already sufficiently remunerative, new capital will flow into it easily, and the main questions at issue are :

- (1) Whether such capital has been yielding a satisfactory return on the basis of present experience ;
- (2) Whether new capital has been going into the industry within recent years.

By the evidence based on these factors, it may be possible to decide whether the profits earned in the industry, and, as a consequence, the prices charged, have been excessively high or otherwise. We shall deal with the question in a later chapter.

It is sufficient to note here that the factors already mentioned have had (on the heavy plant side of the industry) the effect not merely of cutting down prices to a minimum, but also of discouraging the entrance of new capital into the industry. Table I. shows movements in capital expenditure and investment since 1904, as well as new capital issues.

The information given in this Table is based partly on the returns issued by the Electricity Commission since 1921, partly on the returns of loans sanctioned by municipal undertakings prior to 1921, as far as electricity supply is concerned. The new capital issues were taken from the *Economist* and include the capital raised for overseas undertakings as well as home undertakings, with a small percentage for telegraph and telephone companies. The capital raised by electrical manufacturers was taken from *Garcke's Manual of Electrical Undertakings*. The Table shows, that in electricity supply, as distinguished from electrical manufacture, the increase between 1903 and 1919 was about 160 per cent, but during the nine years between

CAPITAL INVESTED IN THE ELECTRICAL INDUSTRY

1919 and 1928, the increase was 175 per cent. This shows a very rapid acceleration in the inflow of capital into electricity supply. A similar observation may be made regarding the new capital issues, which, of course, fluctuate violently from year to year and show no well-defined movement prior to 1925, but since 1925 there has been very great expansion. Electrical manufacture, on the other hand, remained stationary from 1905 to 1917, sufficient indication of unprofitable operation, and it has only been since 1920 that a real expansion has taken place. The capital increase in the industry is very much less than that recorded in electricity supply, and is sufficient indication of the fact that the profit-earning capacity of this branch of the industry has not been such as to attract capital continuously in a volume relatively the same as that of electricity supply.

TABLE I—CAPITAL INVESTED IN ELECTRICITY SUPPLY AND IN
ELECTRICAL MANUFACTURE IN GREAT BRITAIN

1903-1928

(Sterling)

Year.	Estimated Total Capital Expenditure by Public Supply Undertakings.	New Capital Issues by Electricity Supply Companies (including Telephones and Cables).		Electrical Manufacture.
		Annual Increment.	Aggregate.	Aggregate.
1903	£41,300,000	—	—	£29,852,575
1904	—	£2,825,900	£2,825,900	35,768,000
1905	57,400,000	2,837,700	5,663,600	38,644,000
1906	—	5,316,400	10,980,000	40,325,000
1907	66,500,000	10,471,200	21,451,200	42,053,000
1908	—	4,338,900	25,790,100	41,758,000
1909	73,200,000	7,194,500	32,984,600	42,486,000
1910	—	6,160,000	39,144,600	41,693,000
1911	76,500,000	6,188,800	45,333,400	41,503,000
1912	—	9,416,700	54,750,100	44,767,000
1913	79,600,000	6,916,400	61,666,500	47,062,000
1914	—	6,746,400	68,412,900	46,703,000
1915	88,300,000	546,900	68,959,800	46,420,000
1916	—	102,400	69,062,200	46,049,000
1917	94,800,000	214,000	69,276,200	44,540,000
1918	—	2,111,500	71,387,700	48,428,000
1919	107,200,000	9,285,300	80,673,000	61,118,000
1920	—	6,247,000	86,920,000	63,908,000
1921	143,716,000	5,677,800	92,597,800	76,993,000
1922	158,224,000	4,851,800	97,449,600	80,848,000
1923	173,858,000	10,454,200	107,903,800	80,915,000
1924	194,020,000	9,683,400	117,587,200	84,684,000
1925	217,038,000	7,960,900	125,548,100	90,950,000
1926	238,728,000	13,667,800	139,215,900	89,291,000
1927	266,000,000 *	12,764,700	151,980,600	101,371,000
1928	295,000,000 *	15,179,200	167,159,800	—

* Estimated.

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

Quite apart from any action on the part of the manufacturers themselves, economic and technical conditions have tended to limit competition very considerably, and these conditions will operate in the future to narrow down competition still further in a large number of products which enter into the generating plant and transmission equipment category. Thus, in time, for example, a limited number of firms may be dealing with the entire demand of the country in such products, and these firms may be brought together financially to form a combination under one control. It is easy then for such amalgamations to form international agreements and limit competition to the very minimum possible. The economic alignment of the industry is such that a consummation of this nature may be brought about if the consumer himself, through co-operative action, insists on playing off one firm against another with a view to securing what are, for the manufacturer and eventually for the supply undertaking, uneconomic prices.

As an alternative to such trustification, co-operation among producers, based on exact knowledge of the market and a more reasoned adjustment to economic changes within it, reproduces all the benefits of limitation of competition without any of its defects. Experience has shown during the post-war decade that such co-operation, as far as the British electrical manufacturing industry is concerned, has prevented the industry from following in the footsteps of the depressed basic industries and has not prevented electricity supply, at the same time, from realizing a high standard of prosperity. The capital expenditure on power equipment in this country since the conclusion of the war is, measured on a kilowatt basis, almost the lowest in the world, and it is interesting to find that more than 90 per cent of such expenditure has been met by home production.

The second main group to be noted in the electrical manufacturing industry is that devoted to the manufacture of products destined for consumption. In the previous case we have been dealing almost entirely with the manufacture of plant destined to produce commodities for consumption. In the case of electricity supply, the commodity is electricity itself, which is used either in secondary power plant or directly in consumers' apparatus. A similar observation applies to the manufacture of equipment for industry and transport, since, in both these cases, the equipment is destined either to produce commodities for general consumption or to transport such commodities, which is tantamount, in an economic sense, to production. Practically all the observations we have made regarding the direction of demand and the effect of various factors on the technique and finance of production, applies to the provision of industrial equipment and railway electrification material.

Few of these considerations are of any moment, however, in the group devoted

CO-OPERATION AND THE LIMITATION OF COMPETITION

to articles of consumption. Among these may be mentioned small motors for all purposes in the household, in commerce, and in industry, even including industrial motors up to 100 H.P., domestic apparatus of all kinds, distribution cables and wiring supplies, lamps, small transformers and small switchgear, meters and commercial instruments where they are not used in connection with generating plant, fixtures, fittings and accessories, radio, wireless, telegraphic, and telephonic apparatus, and electro-medical supplies.

It is obvious that some sections of this group belong both to the capital and consumption sides, but a fair test of arrangement lies in the possibilities of mass-production being introduced into their manufacture. Without exception, the basis of success and of competitive efficiency in this group lies wholly in a large standardized output, where manufacture in series with the maximum employment of machinery, and the use of highly skilled workers reinforced by semi-skilled and female labour, are distinguishing characteristics. In this section less emphasis is placed on quality and on special types. The price remains the dominating factor; while in accessories and domestic apparatus the question of taste and design may be of significance in determining the direction and volume of demand, it is true to state that the market in these products is affected by the state of competition, by prices, and by the cost of electricity itself. Quality may command a higher price, but seldom more than 5 per cent. Such products are in steady demand throughout the year and are less subject to fluctuations in the national economic sphere. Trade depression, for example, affects them very slightly, owing to the fact that the output of electricity is moving upwards almost without interruption, and all these products are necessary to the immediate consumption of electricity. In their case a reliable index of production is that provided by the output of electricity itself, and, in spite of the fact that competition remains very keen, they may be expected to yield a satisfactory margin of profit. The market is expanding rapidly enough to keep productive capacity fairly well employed. An exception is made, of course, in the case of small industrial motors which share in the vicissitudes of trade. This section of the industry is not marked by the movement towards large units. In the case of distribution transformers and switchgear, a similar observation may be made, although it may be necessary to meet more exact specifications; the volume of output may be considered as equivalent to a steady manufacturing load throughout the year sufficient to act as a balance to the more heavily fluctuating demand in large generating plant and equipment.

A number of special firms are to be found in this group as in the first group, but the composite firms which straddle the entire industry are responsible for a high

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

percentage of the national production. Such materials have a very high capital turnover, twice or even four times as high as the capital invested, so that even if their profit-earning capacity per unit is small, it can still be relatively half or a quarter that of the heavy generating plant and yield the same surplus at the end of the year. It is possible, therefore, to manufacture at close margins with less risk, and the capital involved in research, in development, or in design is spread over a much larger quantity. Speed in production, even at the cost of a slight increase in waste both of materials and energy, may be justified.

It is unnecessary to go more deeply into this side of the industry since it is bound up fairly closely with the development and consumption of electricity itself, but one important tendency can already be seen when a comparison is made between the first and second groups. The introduction of the very large unit at a low cost per kilowatt with the extension of high-voltage transmission systems, which is the practical realization of the theory of centralized or co-ordinated production with power supply over very wide areas, has tended to reduce the revenue earned by the manufacturing industry in supplying such equipment, while conversely it has increased the revenue from the distribution side. In other words, it is less expensive now for the supply undertaking to develop the generation and main transmission of electricity than it is to open up a big industrial, domestic, or commercial load, while the wide diversity of use of electricity for purposes other than lighting has multiplied enormously types and capacities of consumers' apparatus. The consequence is that the balance of the manufacturing industry is changing. Only a few years ago the weight of production lay undoubtedly in heavy generating plant, large industrial motors, main transmission cables, and overhead lines, but now production is becoming much more important in small transformers and switch-gear and in consumers' apparatus generally. This means a new alignment of forces within the industry, which is not calculated to render easy the work of co-operation on a horizontal basis. In the smaller products limitation of competition would appear to be impossible, since they present no technical or financial obstacles to the entrance of new capital and new manufacturing enterprise. It is also in this section that foreign firms enjoying low labour costs have been most successful in developing outlets in this country. In heavy generating plant, their percentage of the market requirements tends more and more to disappear. It is only through the diversity of production that the decline in the heavy branch can be met by a heavy increase in the consumers' branch and a sound economic balance be maintained in the industry.

A third group which has been tentatively distinguished covers the manufacture

THE RECENT DEVELOPMENT OF POWER FINANCE

of scientific instruments and, to some extent also, the manufacture of wireless. Wireless from the entertaining point of view may be regarded as a separate industry, with problems quite apart from those which affect electrical manufacturing proper, and it will not be discussed here, while a similar observation may apply to scientific instruments using electricity where they are not associated directly with the production or consumption of electricity. They belong to an allied industrial group, and enter, of course, into trade statistics. Many of the observations already advanced in connection with the consumption group would not apply to it, with the exception, however, that in this section research and development expenditure are essential to the maintenance of a strong market position.

Power finance is a development which might be expected from the nature of the electrical manufacturing and electricity supply industries. Electricity had to force its way into the international industrial body, which was already dominated by other power industries in direct competition. The justification for its existence at all was, of course, purely economic; it supplied power for lighting, for manufacturing, and for heating purposes, much more effectively than any other form of energy. To render it possible, however, for an industry to evolve round such a process of substitution and of expansion, special facilities and special methods were required. It was not sufficient to trust to a process of evolution and to changes in expert opinion, because already a formidable body of vested interests had come into existence, which was directly opposed to the introduction and expansion of the new industry. Such opposition found expression, for example, in this country in the early legislation devoted to electricity undertakings and their distribution rights, and it was only in 1926 that something like a rational system was introduced into the country. Again, an electricity supply system requires very heavy capital expenditure, and, in the early years of development, such capital expenditure was not always remunerative. Until quite recently there was a speculative element in the industry which sufficed to deter the ordinarily conservative types of investor and to weaken the power of the industry to raise its capital needs at an economic rate.

The electrical manufacturing industry found itself, therefore, confronted with the necessity of creating a market and of maintaining that market in constant activity. It had recourse to the power finance system, whereby special development companies were created to finance large contracts, survey power possibilities, and raise the capital necessary for the realization and practice of such possibilities. The power finance company might carry out the functions of a pure investment trust with the risk spread over a considerable number of undertakings, so that failure in any one of them would not jeopardize its position. Such a trust might create special power

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

supply companies and supply them with their initial capital or guarantee public issues. It might also buy up companies to carry out a process of amalgamation, its activities in the latter case being devoted to acquisition and to deliberate expansion on a large scale. There are numerous examples of such power investment trusts in existence, but they are not altogether typical of power finance as we understand it.

A more effective type is to be found in that which combined consultative engineering work with financial support. Such a company would not only carry out surveys, but it would create and maintain a more extensive service, it would elaborate necessary specifications, call for tenders, and allocate contracts for plant and equipment. It might also carry out those duties for existing companies and obtain control over them through the exercise of this consultative power. As a necessary adjunct to such activities, it would be in a position not merely to advise on contracts but also to secure the necessary financial accommodation while these contracts were being carried out and the power plant installations were being erected. An extension of this system might be found in the combination of power investment and consulting engineering work on the largest possible scale, and recent international groups have moved in this direction.

A third type may be found in the development company proper, whose function lies in the financing of power contracts secured by the manufacturing firms with which it might be connected. Such a development company can be more active in export trade possibilities, but it has not yet been developed to any great extent in this country, the tendency being for the electrical manufacturer to secure accommodation direct from the joint-stock banks on the basis of his own assets alone or, if the contract is allocated by a very powerful financial undertaking, such as a large municipality or a state, on the contract documents themselves.

It might appear unusual for the electrical manufacturing industry to adopt the power finance principle in view of the facilities which apparently exist in this country for the expansion of trade. This observation applies, above all, to such institutions as issuing and merchant banks, who specialize in the financing of public capital issues and underwriting capital extensions for which public investment is invited. Such issuing houses, as work carried out in South America proves, can be a very powerful trade asset, but since the conclusion of the war they have become decidedly more international in their activities and are not primarily concerned with the advancement of British trade alone. They concentrate attention on the financial soundness of the projects placed before them without inquiring too closely into the destination of the contracts which will accrue under the new capital expenditure. There have been recently particularly glaring examples of foreign firms obtaining

POWER FINANCE VERSUS THE ISSUING HOUSES

new capital in London with the fixed intention of placing contracts represented by such capital with associated manufacturing firms in competition with British firms.

Again, the question might also be raised regarding the investment trust itself. The investment trust might, in itself, be of great benefit to British industry, largely through the fact that it has at its disposal a large amount of capital supplied by very small investors available for investment in large undertakings, but the very necessity of the investment trust to pay a high dividend on its entire capital investment and the policy adopted by certain institutions during the last few years of aiming at capital appreciation in addition to a high dividend return, have served to divert British capital to foreign investments and to new foreign issues which are not calculated to be of any assistance to British trade. Under present conditions, one cannot expect from issuing houses, investment trusts, and similar institutions the consistent support which is necessary to the development of active home and export trade, and industry has been forced to develop more and more fully the power finance idea.

There is no doubt that the future should see a very rapid expansion. The movement towards large units and large power systems with very heavy initial capital expenditure must increase the demand for the type of accommodation which is offered by the power finance concern, while it is increasingly true that new power possibilities are not only being discovered but are also being worked out by the latter working in close association with manufacturing groups. The development of power finance must be ultimately favourable to international co-operation since the activities of finance groups cover almost inevitably a large number of countries where other finance groups are operating, and direct competition of the type experienced by electrical manufacturers is not to be found in power finance. Consequently the incentive towards mutual arrangement is greater and, through the reality of such arrangement, the manufacturing industries may also come into closer contact. The situation has become in recent years enormously intricate, and will only move towards simplification when the power investment and power finance trust as such will have reached a point of maximum development. No one can tell with any degree of accuracy when this will take place, but it is already sufficiently clear that the future of electrical export trade especially lies to some extent in the hands of the power finance concern. There may also be an extension of the development company in the case of national electrification where special facilities are required for conversion of the basic industries to electric drive, especially where the latter are not in a position to raise sufficient capital easily for such conversion. We

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

are only now at the beginning of the large-scale application of finance to the scientifically regulated expansion of electrical power consumption.

This consideration brings us to the electricity supply industry itself. The present monograph is only concerned with electricity supply inasmuch as it affects electrical manufacture. We have already indicated certain important movements which are becoming more significant with the course of time. Electricity supply has some of the characteristics of agricultural production inasmuch as it has a certain limited earning capacity per unit of capital expenditure. In other words, to expand its output, it must be prepared to expend a definite capital sum on distribution systems and distribution lines. These systems, when they reach a certain maximum load as the result of increased demand from the electrical consumer, necessitate the installation of new generating plant in the main power stations with additional transmission lines and controlling and transforming apparatus, and the cycle goes on without interruption where potentialities have not been fully exploited. It is possible to increase revenue-earning capacity through a system of interconnection where a number of isolated loads are built together and brought into one transmission system. It is the aim of the supply engineer, above all, to improve what he terms his "diversity factor"—in other words, to secure as wide a range of demand as possible, so that some degree of compensation can take place between one section of the demand and another. He may not be able to maintain a steady curve throughout the day or week or month or year, but he is able to ensure a more continuous operation of distribution, transmission and generating systems, with a consequent reduction in capital expenditure on extensions and a lower overhead cost per unit of output.

Again, the industry is peculiar through the fact that it has the greatest potential market in front of it of any in the world, and this market reacts at once to a reduction in the selling price of electricity. A reduction in price, as experience has shown, almost invariably means such a growth in demand that the net revenue accruing to the supply undertaking within limits imposed by necessary capital expenditure, is increased. There is, as we have already indicated, an optimum return on capital expenditure beyond which it is difficult for a supply undertaking to go, and the very existence of such an optimum return should be an incentive to such undertakings to bring their prices down to an economic minimum. It is still the case that certain undertakings have secured a higher return on their capital expenditure merely through the fact that they have charged what must be regarded as excessive prices and, through the possession of a monopoly, have forced an irreducible minimum of consumers to meet, through the price they pay, capital costs which should more

PRICE POLICIES AND CAPITAL EXPENDITURE

equitably have been spread over several times the demand already handled. There is a point where demand can be stimulated so greatly as a result of proper price adjustment that an optimum return is reached almost at once and the undertaking can expand its capital expenditure almost indefinitely with the sure knowledge that a satisfactory return will be made on it. There is room for a very close examination of the electricity supply industry from this aspect, and it is interesting to note that some such conception of an optimum return has been at work in the United States, where supply undertakings have devoted special study to it. This kind of policy encourages service and the extension of facilities for power consumption, and such facilities are essential to the continuous expansion of demand. The American statistics are in themselves sufficient evidence of the economic justification of such a principle, but it requires to be analysed in every detail before it can be widely adopted.

Examination of the statistics at our disposal referring to Great Britain proves that profits cannot be expanded indefinitely merely through the realization of a higher productive capacity, and certain experts have made incorrect calculations based on this assumption. The electrical manufacturing industry is directly interested in such principles, largely through the fact that the impetus or the incentive towards the fullest industrial electrification lies in the price of electricity as quoted by the public undertaking, and it is possible to establish for a number of industries what may be regarded as an economic price for electricity. This economic price has not been generally quoted in the industrial areas of Britain, with the result that the installation of electrical equipment in the basic trades has been seriously retarded.

Again, development expenditure has not been adequate in electricity supply, owing to the prevalence of the conception that a high price per unit is justified merely on the basis of return on capital expenditure. If supply undertakings adhered instead to the conception that their system should have a definite revenue-earning capacity, and if they set out to increase to the very maximum their distribution system and their demand factor, the position of Britain electrically would be enormously improved. Load-building can justify a very heavy capital expenditure, even in agricultural areas, and the growth of electricity in the future must depend on a policy of load-building with carefully reasoned and accurately detailed schemes.

This whole subject merits the most minute investigation, since the issues involved are important and there is need for some form of theory which will not only guide policy but serve to concentrate effort along broad lines. Both electricity supply and electrical manufacture are changing so rapidly that it would be premature to carry

THE ECONOMIC CONFIGURATION OF THE INDUSTRY

to a logical extreme the ideas already formulated in this chapter. We have touched on certain developments and certain potentialities which emerge from any survey of what has occurred in both sections of the industry. It is customary, of course, to distinguish very clearly between electricity supply and electrical manufacture, but this distinction, if carried too rigidly into practice, means lack of co-operation with its influence on the course of economic expansion. Electricity supply reacts on manufacturing practice even as manufacturing practice may react on electricity supply schemes, and as we have already noted, certain developments, especially during the last few years, have played their part in bringing supply and manufacture closer together. In the possibility of such co-operation lies perhaps the greatest possibility of electrical power expansion in the future of this country.

**ELECTRICAL MANUFACTURE : MANUFACTURING,
FINANCIAL, COMPETITIVE, AND LABOUR CONDITIONS**

CHAPTER II—ELECTRICAL MANUFACTURE: MANUFACTURING, FINANCIAL, COMPETITIVE, AND LABOUR CONDITIONS

I.—PRODUCTION

IN the previous chapter a distinction was drawn between sections of the industry producing goods for capital purposes and other sections producing goods for consumption. This distinction can only be preserved with difficulty when an examination is made of actual output, since no firm has specialized to such an extent that it belongs either to the first category or to the second category alone. The position is complicated further by the necessity imposed on the industry to export a very high percentage of its output, so that specialization, while it has taken place in a number of important branches of the industry, is more a specialization in type of product than in use. Thus, a firm manufacturing transformers does not as a rule concentrate on large power transformers of 1000 KVA. and upwards; it is quite prepared to supply transformers for radio-receiving sets from the same works or from the same organization which can turn out very large apparatus up to 80,000 KVA. The distinction already made is significant of the economic evolution of the industry, not necessarily for the disposition of manufacturing equipment within it. It is possible to say that the development of large distribution systems may necessitate a much higher demand for distribution equipment, without determining movements which aim at meeting such a demand.

Again, there has been a tendency to speak of the electrical industry as manufacturing only what may be defined as electrical products, such as generators, motors, and similar equipment, but the industry as it has evolved in the majority of countries enters into mechanical engineering, inasmuch as it includes prime-movers, such as steam turbines and auxiliaries, as well as turbo-blowers and compressors. The mechanical side of the industry is not negligible, although it has progressed less rapidly than the purely electrical. In an examination of output this mechanical section must be included as an essential part of the industry.

The position as indicated in the 1924 Census of Production, with a comparison between Great Britain and the United States, is given in Table II. The American figures afford some criterion for assessing the importance of the various items given in the total. There is a close resemblance between the principal products from the point of view of relative importance, the main difference being in control and switchgear, insulating wires and cables, wireless and lighting and starting sets.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS'

In each of these cases, the development of exports either by Great Britain or the United States has been responsible for the differences involved.

TABLE II—PRODUCTION OF ELECTRICAL MACHINERY AND APPARATUS IN GREAT BRITAIN AND U.S.A.

Classification.	Great Britain (1924).		U.S.A. (1925).	
	Value.	% of Total.	Value.	% of Total.
Generators, transformers, and rotary converters	£4,942,000	7·4	£21,600,000	6·8
Motors (including fans)	5,590,000	8·0	25,800,000	8·1
Meters and instruments	1,646,000	2·3	6,555,000	2·1
Control and switchgear	3,538,000	5·4	6,450,000	2·0
Switchboards	1,659,000	2·3	14,400,000*	4·5
Insulated wires and cables	18,444,000	26·4	38,000,000	11·9
Batteries and accumulators	4,288,000	6·1	32,000,000	10·0
Lamps	2,432,000	3·5	15,200,000	4·8
Telegraph and telephone apparatus	3,872,000	5·6	18,100,000	5·7
Wireless	6,107,000	8·6	36,400,000	11·4
Lighting and starting sets	600,000	·8	13,900,000	4·4
All others	16,820,000	23·6	90,595,000	28·3
Total	£69,938,000	100·0	£319,000,000	100·0

* Contains switchgear items as well as switchboards.

The previous Census figures—namely, for 1907—are given for both countries in Table III. Since 1907, output in Great Britain has increased by 404 per cent, and in the United States by 540 per cent, but it is significant, in view of what has

TABLE III—PRODUCTION OF ELECTRICAL MACHINERY AND APPARATUS IN GREAT BRITAIN AND U.S.A.

(1907)

Classification.	Production in 1907.		Increase 1907-1924.	
	Great Britain.	U.S.A.*	Great Britain.	U.S.A.‡
	£	£	Per cent.	Per cent.
Generators, transformers, and rotaries	1,236,000	5,650,000	300	283
Motors	1,729,000	6,100,000	224	324
All other machinery	1,249,000	2,900,000	425	620
Insulated wires and cables	5,256,000	10,600,000	252	258
Batteries and accumulators	549,000	2,180,000	682	1370
Lamps	465,000	3,240,000	425	370
All other apparatus	3,413,000	19,330,000	—	—
Total	£13,897,000	£50,000,000	404	540

* 1909 statistics, which, owing to trade depression in 1907 and 1908, were about the same as in 1907.

‡ 1925 statistics equivalent to those of 1924.

ELECTRICAL AND ALLIED MACHINERY PRODUCTION

already been stated, that generators, transformers, and other power plant equipment should only have increased by 300 per cent in Great Britain and 283 per cent in the United States—a fairly clear indication that the change in balance of production in the industry, which has already been mentioned, had begun before 1924.

To those electrical totals should be added the mechanical, accounting for rather more than £3,500,000 in 1924, steam turbines accounting for £1,211,000, steam condensers for £899,000, and other electrical equipment for the remainder, so that the real turnover of the electrical and allied industry which is under consideration was, in that year, not less than £75,000,000, including a number of items such as scientific instruments which are not given in the Census as belonging to the industry. Electrical and allied engineering proper accounted for £21,637,000. The corresponding production in 1925 was £23,490,000, in 1926 £24,790,000, in 1927 about £24,000,000, while in 1928 it had fallen to £23,800,000. For the entire industry it was about £85,000,000 in 1925, about £84,000,000 in 1926, in excess of £86,000,000 in 1927, and showed a slight recession in 1928. For electrical engineering itself, additional information is available, sufficient in itself to allow us to establish the position from 1920 onwards.

TABLE IV—PRODUCTION OF ELECTRICAL AND ALLIED MACHINERY AND APPARATUS IN GREAT BRITAIN †

Year.	Steam Turbines, Condensers, Pumps, etc.	Turbo-Generators, Rotary Converters, Motors and Generators, Transformers, Motor-driven Devices.	Control and Switchgear, including Accessories.	Switchboards.	Meters and Instruments.	Total.
1913	£1,720,000	£4,700,000	£965,000	£455,000	£640,000	£8,480,000
1920	2,720,000	11,600,000	2,900,000	1,360,000	1,740,000	20,320,000
1921	2,700,000	14,600,000	3,800,000	1,800,000	1,420,000	24,320,000
1922	2,200,000	7,500,000	2,400,000	1,100,000	1,200,000	14,400,000
1923	3,000,000	9,500,000	3,100,000	1,450,000	1,400,000	19,450,000
1924	3,500,000	11,294,000	3,538,000	1,659,000	1,646,000	21,637,000
1925	4,100,000	12,000,000	5,600,000	*	1,790,000	23,490,000
1926	5,100,000	12,200,000	5,700,000	*	1,790,000	24,790,000
1927	3,600,000	12,800,000	5,900,000	*	1,850,000	24,150,000
1928	4,400,000	11,600,000	6,100,000	*	1,700,000	23,800,000

† This table gives, of course, no indication of the increase in volume.

* Included in switchgear.

The increase recorded in mechanical plant alone—namely, steam turbines, condensers, pumps, and allied products—was about 74 per cent from 1913 to 1923 and 158 per cent to 1928. In electrical plant, which includes turbo-generators,

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

rotary converters, motors, transformers, and motor-driven devices, the corresponding improvement from 1913 to 1923 was 102 per cent, and from 1924 to 1928 it improved less rapidly than mechanical plant and was 148 per cent above that of 1913 measured in values alone. Control and switchgear showed an even greater rate of increase from 1913 to 1923, being 220 per cent, and in 1928 its output was more than six times that of 1913. Instruments and meters showed an increase of 120 per cent during the ten years after 1913, and have now rather less than three times the output of that year. For all products within these four groups the rate of increase from 1913 to 1923 was 130 per cent, and the 1928 figure is almost three times that of 1913.

These statistics are impressive in themselves. They do show that the industry has moved upwards very rapidly in fifteen years, but, during the last three years especially, owing to circumstances which together have retarded progress, the curve of increase has shown a tendency to straighten out, and the industry has not, as a consequence, fulfilled the expectations of those who assumed at the conclusion of the war that the rapidity of electrification would be so marked that the power industries would be fully occupied for a considerable number of years. During 1929, however, much of this leeway has been made good as a result of developments in connection with the national electrification scheme, which are discussed later in this monograph.

The statement has been made recently that the industry is now so fully employed that it cannot add easily to its existing industrial capacity. Yet, as far as the products enumerated in the table above are concerned, the statement has no validity. The industry is now in a position to increase its production by at least 40 per cent. Since 1924, for example, switchgear factories of very great size have been erected sufficient to double the capacity of certain plants. Transformer shops have been extended by practically every transformer manufacturer much in the same proportion. There have been important developments in the production of domestic and small consumers' apparatus, and even in heavy generating plant, largely as a result of rationalization, a very great increase in production can be undertaken without severe strain. We have no knowledge of the situation in other sections of the industry, but it is very probable that in those sections a work of sufficient modernization has been carried out to improve their position.

In all sections, particularly in electric motors, there is excess productive capacity, owing entirely to the state of depression which has ruled in the industry since 1921. The natural expansion of this branch has been seriously checked, with the result that there is a high percentage of reserve plant not yet brought into full use.

ANALYSIS OF THE POST-WAR TRADE CONDITIONS

On the whole, therefore, one can place the productive capacity of the industry in excess of its present output as rather more than 40 per cent, so that it can undertake any work of widespread industrial or national railway electrification which economic conditions may cause. The importance of the industry is already apparent from the Census statistics. It is easily the largest section of the engineering group of industries in this country, if automobile construction is excepted. It is responsible for rather more than one-third of the output of the engineering groups.

It is, of course, difficult to give the exact figures of production, owing to a number of factors which enter into even the most perfect census. As a result of a questionnaire issued in 1924 covering firms responsible for the ratios between 60 per cent and 81 per cent of the national output in heavy electrical and allied products, it has been possible to estimate with some degree of accuracy the course of production since 1920 in a number of important groups. Since 1924, additional information, based not on the questionnaire but on a collection of data bearing on the industry, has been used, but the resultant calculations may tend to be slightly conservative. The result is given in Table IV. already broadly analysed.

It is quite clear that the industry has gone through two cycles of prosperity and depression since the conclusion of the war. The year of greatest prosperity was 1921 following on the trade boom of 1920. The engineering lock-out and trade depression generally caused a very heavy slump in 1922. This slump affected more directly electrical than mechanical plant, while meters and instruments survived it with much less difficulty than any other section, due possibly to the fact that they are less affected by trade and more by the general growth of electricity. Recovery was very rapid from this period of slump with a point of maximum output in 1926. Since 1926 a period of fairly steady output has intervened, accompanied by falling prices and a definite increase in volume as measured in horse-power. This increase in volume, while it has had its effect in the absorption of more labour, has been accompanied by a serious reduction of profits. A further observation may be made to the effect that general trade conditions, either of depression or prosperity, are reflected in electrical manufacture with the lag of one year. Thus the collapse of 1921 resulting from the coal strike affected electrical manufacture in 1922. Similarly, the crisis of 1926, which was less severe owing to the fact that it was not accompanied by deflation in prices, interrupted the expansion of the industry in 1927 and still had a certain effect in 1928. The one section which has moved upwards practically in a straight line since 1922 has been control and switchgear, and it is rapidly becoming one of the most important sections of the engineering branch of the industry. The development of the national scheme must serve to

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

make it still more important, with the result that one would expect the productive capacity of the industry to increase much more rapidly there than in any other branch, with the possible exception of transformers.

TABLE V—PRODUCTION AND CONSUMPTION OF ELECTRICAL AND ALLIED MACHINERY AND APPARATUS IN GREAT BRITAIN

Year.	Total Production.	Exports.		Production for Home Consumption.		Imports.		Total Consumption.
	Value (£).	Value (£).	% of Total Production.	Value (£).	% of Total Consumption.	Value (£).	% of Total Consumption.	Value (£).
1913	8,480,000	3,204,000	37·0	5,276,000	77·5	1,533,200	22·9	6,809,200
1920	20,320,000	3,925,700	19·3	16,394,300	90·0	1,841,100	10·0	18,235,400
1921	24,320,000	6,169,600	25·4	18,150,400	93·8	1,197,300	6·2	19,347,700
1922	14,400,000	5,450,000	36·4	19,350,000	86·0	1,379,900	14·0	10,729,900
1923	19,450,000	5,317,000	27·3	14,133,000	91·0	1,389,900	9·0	15,522,900
1924	21,637,000	6,697,000	30·8	14,940,000	90·5	1,578,300	9·5	16,518,300
1925	23,490,000	7,112,600	30·3	16,377,400	90·2	1,726,000	9·8	18,103,400
1926	24,790,000	7,110,000	28·7	17,680,000	91·0	1,739,100	9·0	19,419,100
1927	24,150,000	8,010,000	33·3	16,140,000	88·2	2,166,500	11·8	18,306,500

In Table V. an attempt has been made to follow movements in the national consumption of the products listed in Table III. The export figures are based on the trade returns, with the exception that, in mechanical plant, we have been forced to rely on other sources for this information owing to the lack of detail in official returns. The statistics as they stand come close to accuracy, and they give on the whole a reassuring picture. Exports have risen virtually in a straight line since 1922, and if allowance is made for the fall in prices, 1927 figures must be more than twice those recorded during 1922. The industry, therefore, is highly competitive in export business. A further point of some importance lies in the fluctuations in the percentage of exports to total production, and this has been due to exports compensating to some extent for declines in the home demand. The increase in the export percentages coincides almost entirely with the decrease in home consumption and vice versa. Two years are specially noteworthy in this connection, 1922 and 1927. 1913 is significant as showing that the industry was actually forced to export a much higher percentage than it should have exported if conditions in the home market had been more favourable. This would indicate not merely excessive competition abroad, but also excessive competition at home accompanied by unnatural competitive prices.

This observation is borne out by examination of the statistics of production for home consumption. In 1913, the industry only supplied 77·5 per cent of the home

[26]

ERRATUM

Line 2 below table "consumption of products listed in Table III" should read Table IV.

HOME CONSUMPTION AND EXPORT SHIPMENTS

demand, imports accounting for 22·5 per cent—a thoroughly unhealthy situation. In the post-war years the position has enormously improved, imports accounting now for about 9·5 per cent, and it should be noted that these imports are different in character from pre-war imports inasmuch as the electrical manufacturers themselves have been responsible for a fairly high proportion of them, much of it being, in turn, re-exported in a more highly finished form. It is very difficult, therefore, to decide with any degree of accuracy what proportion of those imports is in direct competition with the British product, particularly in small apparatus. A reasonable estimate of competitive imports would probably place them now at 7 per cent. 1921 was undoubtedly the best year, owing to the combination of the boom of 1920 and economic disturbances in Europe. The period intervening since 1924 may be regarded as representative of more normal conditions, and it is significant that practically no change has occurred in the percentage of the home demand carried out by British manufacturers since that time. The incidence of one very large contract raised the 1927 import figures to an abnormally high level, but the position since then has undoubtedly improved.

The statistics of consumption itself show that expansion has not been so rapid as one might have expected. This may be due to the influence of falling prices cloaking a very large increase in volume, to the effect of trade depression, and to the delay in developing the public supply of electricity owing to legislation difficulties. One would expect from 1929 onwards a very rapid increase in consumption as a result of the activities of the Central Electricity Board, so that one may regard this whole post-war decade as a period of sub-normal activity. In any case, consumption shows an increase of 170 per cent over 1913, production 190 per cent, and exports 150 per cent, and production for home consumption alone 210 per cent, so that the competitive position of the industry has improved considerably since 1913. Exports show the greatest relative increase, a thing specially desirable in view of their effects on the national economy and on the national balance of payments, but there may be, of course, a certain danger in developing too greatly exports on an excessively low price, and, if the level of export price is too low, it may be advisable to concentrate on home production. The problem of adjustment is very intricate and difficult.

The industry outside of the groups already mentioned cannot be examined with the same detail, owing to the fact that statistics are not available beyond those of the Census of 1924. According to that Census, the total production of electrical goods, other than those given in Table IV., and excluding contracts for repair and maintenance work, amounted to £45,900,000, and of this total £10,235,000 were exported, equivalent to 22·3 per cent, while re-exports amounted to £3,182,000.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

The national consumption was, therefore, £38,847,000, and of this imports accounted for almost 8 per cent, home production covering, therefore, 92 per cent. There is little difference between these figures and the figures given in Table V. for the same year, beyond the fact that the engineering section of the industry is much more active and much more effective in export trade. An explanation for this may possibly be found in the fact that progress in home demand in other products has been so rapid that expansion of exports has become less necessary to the continuous economic activity of the industry.

It is difficult to establish a pre-war production figure for electrical and allied production including all items. Exclusive of repair and contract work, it was in 1924 £69,000,000, and, inclusive of the latter as already stated, about £75,000,000. On the analogy of Table III., one would expect the pre-war output to be slightly in excess of £25,000,000, the purely electrical section amounting to £23,280,000. In 1907, the corresponding figure for purely electrical products was £13,987,000, imports amounting to £1,911,000, and exports to £3,667,000. Internal consumption was, therefore, £12,141,000, imports accounting for 15·7 per cent. Exports were 26·4 per cent of the total production. On the evidence of these figures alone, the economic position of the industry had undoubtedly become worse between 1907 and 1913. Competition had intensified in the home market, and the necessity to make good the decline in the position by increasing the volume of exports gave unnecessary prominence to shipments on export account. The industry in 1907 was less out of balance than in 1913, but less out of balance still in 1927 than in 1907. There can be no doubt that, from every point of view, in competitive efficiency, both at home and overseas and in the ability to meet competition as it arises with success, the industry is in a stronger position now than it has ever been.

II.—PRICES AND COSTS

Having analysed the course of production in as minute detail as the information at our disposal would allow, we may devote attention to the relations between costs and prices, with a view to assessing the main factors governing both productive capacity and competitive efficiency. We have already indicated that the industry may be regarded as efficient from the evidence of the percentage of home demand it supplies and its power to maintain a steadily advancing export demand. These observations apply above all to the products listed in Table III.

The main items entering into costs of production are materials, labour, factory and commercial expenses, and taxation. Materials include not only direct purchases

MATERIAL AND LABOUR COSTS IN PRODUCTION

from other industries, but also the finished products passed from one section of the workshop to another. Thus, we might find, for example, that in the heavy engineering department devoted to the manufacture of steam turbines and turbo-generators direct purchases of materials outside, in a highly equipped work with a foundry, would only amount to about 30 per cent of the materials listed in the course of production. In the motor department, the corresponding percentage might be 33 per cent. In mechanical plant, such as turbine construction and erection, the percentage on the other hand might be as high as 80 per cent, and in instruments and meters 73 per cent. These calculations are based on results in a typical undertaking, and they show that the market quotation of materials as such may not be an entirely reliable indication of material costs within the factory. Through efficiency and through elimination of waste it may be possible to effect economies in materials much greater than those indicated by the course of prices. On the other hand, the very fact that a high percentage of such materials is worked up through the various sections of the factory intervening between raw materials and the finished product is sufficient to emphasize the importance of labour costs, since labour is the principal item entering into each stage of production or modification. Materials, therefore, may, as shown in the final product, contain a very high percentage of skilled labour with a high remuneration which would not be indicated by a return giving tonnages of raw materials used.

This observation is peculiarly significant in view of the part played by labour as indicated by the cost of wages and salaries. As such it covers all employees in the factory, but not, as a rule, the office or the commercial staff. Labour costs in this case bear directly on production in the workshop and on nothing else, but we have already seen that a high percentage of these costs is also contained in materials, and it is exceedingly difficult to distinguish between the labour which is actually employed in manufacture and the labour which has gone into materials used. To take the sections of the industry already indicated, the labour employed in materials worked in the factory may account for more than 60 per cent of the total material costs in heavy electrical plant, for about 45 per cent in the manufacture of motors, for about 62 per cent in transformers, for 30 per cent in the mechanical department, and 22 per cent in instruments and meters. Such percentages increase, of course, with the movement towards the finished product, except in cases where, as in instruments and meters, the materials purchased are in themselves highly finished products which have been worked up in other factories outside of the industry. A meter shop may only assemble clock-work parts and cases supplied by outside firms.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

Factory and commercial expenses represent the most difficult, and, in a sense, the most uncertain elements in production. There is no standard definition of what is actually understood by a factory expense. As a rule, it represents the cost of production in the workshop remaining after materials and labour have been covered, but it has also a fairly high proportion of labour in it, due to the fact that the workshop is debited with its percentage of the maintenance and depreciation and other costs of the factory. A similar observation applies to commercial expenses, which are generally understood to contain profits as well as the costs of distribution. Such costs of distribution include transport, shipping, insurance, and they cover the selling organization both at home and abroad, and here again they contain a high percentage of labour. The three items, therefore, labour, factory, and commercial expenses, would be expected to move in much the same direction and show similar tendencies either towards decrease or increase.

Taxation does not include income tax, which is generally taken as a charge on profits for which special allowance is made. It does not cover the cost of national insurance included under factory expenses. Taxation, which is beyond the control of the manufacturer, has shown the greatest increase of any item since the war and plays a part in costs which is excessive. To give some idea of the part played by these items in the costs of production between 1913 and 1927, a number of typical undertakings was taken representative of good modern practice, and the results are shown in Tables VI. and VII.

From those tables it is clear that a change has taken place in the distribution of

TABLE VI—DISTRIBUTION OF COSTS OF PRODUCTION
(1913 and 1927)
(Percentage of Total Selling Price)

Classification.	Mechanical Plant.		Electrical Plant.		Transformers.		Switchgear.		Meters.		All Electrical and Allied Products.	
	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.
Materials . .	46·0	44·5	56·0	49·2	62·0	49·0	44·7	44·1	37·4	33·4	48·3	42·5
Productive labour . .	18·0	18·8	14·0	15·1	16·0	19·2	18·4	18·3	25·0	28·2	26·3	28·5
Factory and commercial expenses . .	35·5	34·1	28·8	31·4	20·8	27·0	36·4	33·4	36·8	33·6	23·9	24·3
Taxation . .	0·5	2·6	1·2	4·3	1·2	4·8	0·5	4·2	0·8	4·8	1·5	4·7
Total . .	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

DISTRIBUTION OF PRODUCTION COST ITEMS

these items. In almost every case, the three terms, labour and factory and commercial expenses, represent a much higher percentage of the total costs in 1927 than in 1913, the only exception being switchgear, where the character of the industry is changing so much that it is difficult to establish a direct comparison. If percentages in mechanical plant alone are considered, materials, factory and commercial expenses have decreased, owing possibly to higher efficiency in factory management, while labour and taxation have gone up, taxation much more than labour. In heavy electrical plant, materials have fallen even further, but all other items have increased, taxation again showing the most spectacular upward movement, followed by factory and commercial expenses. The influence of labour costs on the latter is quite evident. In transformers, a similar development has taken place, but allowance must be made also in this case for a change in the character of the industry, owing to the development of special non-standard types and increasing unit capacities. In meters, the increase in labour must be attributed, above all, to the employment of more highly skilled forms of labour to meet the demand imposed on the industry. Both materials and factory and commercial expenses have in this case declined, owing to the realization of mass-production methods necessary to the maintenance of a strong competitive position against the introduction of cheap Continental products. In all products, which covers not representative firms but a group of firms accounting for about 76 per cent of the output of the industry, materials have gone down very markedly, while labour has increased by a little more than 2 points. The main observation which can now be deduced from such an investigation is that the industry has been able to economize quite considerably both in materials and in factory and commercial expenses.

Table VII. shows the increase in the costs of production since 1913 for a number of representative firms, with a general figure for the entire industry, manufacturing the products listed in Table IV. in the last two columns. In mechanical plant, the total increase in the costs of production has been 98 per cent; in electrical plant, 85 per cent; in transformers, 71 per cent; in switchgear, 75 per cent; in meters, 55 per cent; and in all products, 82 per cent. It should be noted that these calculations are based on values only, and not on physical units such as H.P. or KVA. The significance of this difference will be made clear later. Materials show a much smaller rate of increase than any other item. Switchgear constitutes perhaps an exception. Wholesale prices were in 1927, according to the *Statist Index*, about 45 per cent above the level of 1913. Only in two branches—namely, transformers and meters—is the rate of increase less than that of wholesale prices. In other branches it is considerably in excess owing to the effect of high labour

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

TABLE VII—INCREASE IN COSTS OF PRODUCTION
(1913 and 1927)
(Based on Selling Price)
(1913 = 100)

Classification.	Mechanical Plant.		Electrical Plant.		Transformers.		Switchgear.		Meters.		All Electrical and Allied Products.	
	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.	1913.	1927.
Materials . .	100	191	100	163	100	135	100	172	100	138	100	155
Productive labour . .	100	206	100	198	100	205	100	174	100	174	100	216
Factory and commercial expenses . .	100	190	100	200	100	197	100	160	100	141	100	172
Taxation . .	100	1100	100	667	100	667	100	1450	100	950	100	630
Total . .	100	198	100	185	100	171	100	175	100	155	100	182

costs and the high percentage of materials which is used in the electrical factories themselves. Labour gives a clue to the situation, the increase in labour costs ranging between 74 per cent and 116 per cent. Factory and commercial expenses show very similar movements, the range being between 41 per cent and 100 per cent. The most spectacular increase of all is represented by taxation, which for the entire industry represents an increase of 530 per cent. Taxation has now become a very serious burden on production, since its effect is cumulative from the raw materials on through the workshop to the finished article, and, even if it directly accounts for 4.7 per cent of the selling price, indirectly it may account for several times this figure. The industry, as a consequence of the national and local taxation policy, has been deprived of additional resources which are necessary to the successful prosecution of trade and the realisation of competitive efficiency.

Of those four items, the manufacturers have no control practically over labour or taxation. They can economize in materials and, to some extent, in factory and commercial expenses, but the range of economy is not very great. In the past few years a reduction in selling-price has simply meant a reduction in profit, and, in some cases, the elimination of profit. Based on a tonnage value, the increase in the selling-price of electrical and allied products corresponds very closely with that shown in the table, but neither value nor tonnage are reliable indices in this case of the real price paid by the consumer. Tonnage is not a good indicator of value, owing to the fact that there is a much higher H.P. capacity per ton in mechanical

MEASUREMENT OF PRICE BY UNIT OF CAPACITY

and electrical plant now than in 1913, and the very fact of such an increased capacity goes far to explain the difference in the costs of production as based on the selling-prices applied to mechanical and electrical plant, and such products as transformers and meters, which have not been affected by the same developments.

It is difficult to estimate with any accuracy the increase in H.P. capacity per ton of product which has taken place since 1913, but one must still affirm that the only true measure of price lies in cost per kilowatt or per horse-power or per K.V.A., and not per ton. The prices of heavy generating plant in 1927 were probably not much higher than those ruling in 1913 on a physical unit basis, and these prices, taking the entire production of the industry, have tended to move steadily downwards since. We shall touch on this later when the capital cost of generating plant is considered.

The question remains : Has labour efficiency moved up in the same proportion as the increase in labour costs ? In other words, is the difference between the costs of labour and other costs satisfactorily explained by the higher output per unit of enterprise ? An attempt to answer that question is made in Table VIII., where

TABLE VIII—LABOUR EFFICIENCY IN ELECTRICAL PLANT PRODUCTION
(1913-1927)

Year.	Total Man-Hours Worked (000's omitted).	Total Tonnage Produced (Tons).	Tons per 1000 Man-Hours.	% of 1913 (1913 = 100).
1913	29,691·0	42,741	1·44	100·0
1920	35,880·8	47,951	1·33	92·5
1921	31,784·5	48,984	1·54	107·0
1922	24,475·5	33,361	1·36	94·6
1923	31,479·2	48,546	1·54	107·0
1927*	41,500·0	77,200	1·86	129·0

* Estimated.

production in tons per thousand man-hours is given since 1913. The question of wages may be examined later when the international competitive situation is surveyed.

The figures given are not an aggregate for the whole industry but represent a fairly large sample, which may be taken as representative of the most modern practice. A comparison can be made direct between 1913 and the succeeding years, owing to the fact that the same undertakings are under consideration. As the table shows, it has been found impossible to establish reliable figures for 1924, 1925, and 1926, but these years would show a steady increase in volume of output, reaching a maximum in 1926 with a slight decline in 1927, and, accompanying it,

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

an improvement in tonnage per thousand man-hours worked. As an indication of labour efficiency such a calculation is probably the only real one possible. For tonnage it might be possible to substitute horse-power or kilowatts, since, of course, a very marked change has taken place in the power developed per ton of electrical machinery, but this factor is taken care of in the general price changes.

Since 1913 the tonnage of output has increased by 80 per cent, while the total man-hours worked has only increased by 37 per cent, so that the industry is, from this point of view, much more highly organized and much more efficient now than before the war. The improvement in labour efficiency has been of the nature of 29 per cent, and much of it has been due to the fact that the expanding volume of production has allowed machinery to be used at a much higher constant rate than previously. New machine tools of higher capacity and more rapid operation have been installed, and there has been a more scientific distribution of power equipment throughout the workshops. The load factor in industry and the state of equipment have definitely improved. The three years, 1920-22, were years of adjustment to the post-war situation and recorded no improvement on 1913, so that the competitive strength of the industry was not particularly great prior to 1923. Since 1924, considerable adjustments have taken place.

An examination of the distribution of the costs of production shows that labour has been responsible for an excess cost of 19 per cent in 1927 compared with 1913, but against that must be placed the increase in efficiency of 29 per cent, and this increase has served to make good not only part of the fall in prices but also part of the difficulties imposed by excessive taxation. Improvement in production to meet the change in the economic position has been effected by more scientific control of manufacturing processes throughout the workshop, the better employment of machinery and machine tools, the closer co-ordination of internal transport to factory needs, and the abolition of unnecessary intermediate operations. With this should be included the marked tendency within the industry for the units of production to increase very rapidly. This does not necessarily mean that the amount of labour in such large units has decreased. From many points of view, the expansion in unit capacities has necessitated a large capital expenditure. It is interesting in this connection to quote a statement made in a survey of "Recent Economic Changes in the United States," made by a special committee under the chairmanship of President Hoover :

"It should be noted in passing that the development of all modern machinery rests upon the use of so-called machine tools. These basic tools are the lathe, the planing, drilling, milling, and grinding machines, and their variations and deviations. These basic tools have been highly developed both as to

MACHINE TOOL DEVELOPMENT—PLANT CONSTRUCTION

size and accuracy, and fill a most important role in modern production. With such basic callings as foundry work, pattern making, and rolling mills, all other industrial machinery is produced. And what is equally important, they can be made to reproduce themselves. The growth in the size of these basic implements should also be noted. The first lathe, built about 1800, could be carried by one man. Large modern lathes can machine a cylinder 10 feet in diameter, 40 feet long, and the largest boring mill in America can machine work up to 60 feet in diameter. More important still, much larger tools can be constructed, so that, if other conditions warrant it, the size of industrial products can be greatly increased."

During the last few years especially, expenditure on large machine tools has steadily increased, with the result that, while labour efficiency as measured in tonnage per thousand man-hours has gone up, the resultant financial yield to the factory has probably been rather less. This point is elaborated in closer detail later, when the question of net profits comes under consideration. Economies have been effected not merely through the provision of better manufacturing equipment but also through changes in design. As a result of standardization and with one of its consequences in the introduction of exact specifications covering materials in manufacturing processes, there has been a steady reduction in the material actually used, while rated capacities have been more accurately observed. Thus, every element entering into construction, such as copper, laminations, and insulations, has been rated accordingly.

In addition to this saving, which can be found in every product, there is to be considered the effect of changes in practice. Thus, the adoption of fabricated construction for large-capacity turbines, alternators and generators, where the structure is built up on steel plate welded together instead of a steel casting, either cast as a whole or in parts which can be riveted together, has increased the demand for heavy steel plate at the expense of steel castings, which may not be necessarily a saving as measured in initial prices, the cost of heavy steel plate being probably slightly higher than that of steel castings, but the weight of the final product has been greatly reduced, with the result that transport and shipping charges decrease, while, in a number of installations, it has been found no longer necessary to maintain a foundry in existence. In transformer construction, the principle of fabricated construction with steel plate welded together has now been in operation for some years. The savings through such changes in design and practice are, therefore, two-fold.

(a) There is a capital saving through the reduction in use of the foundry, which, in many electrical factories, could not be operated at a constant load factor, owing to the circumstance that it had to be laid out for very large capacities without the reality of a constant demand behind them. (b) There is a saving in weight,

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

through the adoption of a stronger and more reliable material and the introduction of a system of manufacture by parts.

A further development, which is of importance for the consumer, has lain, above all, as already indicated, in the realization of a much higher power capacity per unit of weight of finished product, and capital expenditure on electricity supply systems is generally based on capacity and not on weight. Thus, measured in price per ton, an electric generator may be more than twice pre-war cost-price, but, measured in kilowatts or horse-power, which, of course, decides its earning capacity, it may be actually considerably less. It is difficult to give actual figures of the increase which has taken place in the capacity per ton. Quotation may again be made from the Report of the President's Committee, where a table is given showing the progress in steam-turbine development from 1918 to 1928 :

"The increase in size of steam turbine units has been mentioned. What this increase has meant in recent years in improvement in the water rate and in a few other significant factors is indicated in the following table" (page 37).

This table is interesting as showing four things :

- (1) The development of the large power unit in the ten post-war years ;
- (2) The realization of economies in steam consumption per unit generated, and this, of course, is translated directly into fuel economies ;
- (3) The reduction in the weight per unit of capacity as measured in kilowatts ;
- (4) The reduction in the actual area covered by the plant itself with the resultant capital saving in construction.

Thus the weight per kilowatt rating, as shown in the table, has fallen from 42.5 lb. per kilowatt in 1918 to 13.9 lb. in 1928, the 1928 figure being almost one-third of that for 1918. These figures represent the extreme limits of economy in weight, since, in this country as in the United States, units of a much smaller capacity than 25,000 kilowatts constitute the bulk of production, and in their case the changes have been less marked. In other sections of heavy plant production, such as generators, rotary converters and motors, the reduction effected has been less than in turbo-units, and little change has taken place in switchgear, meters and instruments. In transformers, measured on a KVA. rating, progress has been almost as spectacular as in steam turbines, owing to the introduction of very high voltages. A comparison, therefore, based on price per ton would be inaccurate at the present time, although it might have value as showing tendencies within a limited number of years.

STEAM TURBINE DEVELOPMENT—PLANT EFFICIENCY

STEAM TURBINE DEVELOPMENT IN U.S.A., 1918-1928

	1918-1920.	1921-1924.	1925-1926.	1927-1928.
Largest single-cylinder turbine built	25,000 KW.	30,000 KW.	40,000 KW.	60,000 KW.
Best point water rate (straight condensing)	12.46 lb./KWh.	10.24 lb./KWh.	10.22 lb./KWh.	9.16 lb./KWh.
Steam conditions	185 lb./125° S-28½"	265 lb./214° S-29"	260 lb./214° S-29"	290 lb./700° TT-29½"
Normal speed	1500 R.P.M.	1800 R.P.M.	1800 R.P.M.	1800 R.P.M.
Largest compound turbine built	60,000 KW.	62,000 KW.	104,000 KW.	165,000 KW.
No. of cylinders	3	3	3	2
Best point water rate (straight condensing)	10.58 lb./KWh.	7.56 lb./KWh.	7.97 lb./KWh.	9.12 lb./KWh.
Steam conditions	265 lb./175° S-29"	550 lb./725° TT-29"	550 lb./725° TT-29"	265 lb./290° S-29"
		Reheated between HP. and IP. to 700° F.	Reheated between HP. and IP. to 500° F.	
Normal speed	H.P. 1800 R.P.M. Ea. L.P. 1200 R.P.M.	1800 R.P.M.	1800 R.P.M.	1800 R.P.M.
Other compound turbines built	—	50,000 KW.	80,000 KW.	110,000 KW.
No. of cylinders	—	2	2	2
Best point water rate (straight condensing)	—	10.10 lb./KWh.	9.05 lb./KWh.	8.74 lb./KWh.
Steam conditions	—	265 lb./200° S-29"	375 lb./258° S-27½"	400 lb./258° S-29"
Normal speed	—	1200 R.P.M.	1800 R.P.M.	1800 R.P.M.
Approximate weight per kilowatt rating	42.5 lb.	34.3 lb.	23.2 lb.	14.9 lb.
Approximate floor space per 1000 kilowatts of rating	59 sq. ft.	39.6 sq. ft.	34 sq. ft.	16 sq. ft.

A further factor of importance in deciding the price of heavy electrical plant has lain in the increased efficiency of the plant itself. This efficiency may be measured with reference to an entire power plant installation where the pounds of coal per unit generated can be calculated with accuracy. Tables IX-XII. show the progress that has taken place in the United States and Great Britain since 1920. In the United States and in Great Britain the saving has been of the order of 38 per cent to 40 per cent, the thermal efficiency of generating plant in both countries being much the same, if the American and British coal consumption figures are reduced to the same calorific basis.

Tables X. and XI. are specially interesting through the light they cast on the economic operation of the supply industry and on the influence exerted by the construction of more efficient power stations on the national coal economy. Thus the

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

TABLE IX—FUEL CONSUMPTION PER UNIT GENERATED IN CENTRAL STATIONS

Year.	U.S.A.	Year.	Great Britain.
1920	3·54 lb. of Coal	1920-21	3·40 lb. of Coal
1921	3·16 "	1921-22	3·20 "
1922	2·92 "	1922-23	2·80 "
1923	2·80 "	1923-24	2·71 "
1924	2·58 "	1924-25	2·55 "
1925	2·41 "	1925-26	2·43 "
1926	2·26 "	1926-27	2·33 "
1927	2·15 "	1927-28	2·16* "
1928	2·06 "	1928-29	2·05* "

* Including non-statutory undertakings, railway and tramway authorities.

TABLE X—POWER STATION EFFICIENCY IN GREAT BRITAIN *

Year.	Fuel Consumption per Unit Generated. (Lb. of Coal.)				Overall Thermal Efficiency. (Per cent.)			
	All Stations.	Decrease on 1922-3. (Per cent.)	Twenty-five Most Efficient.	Decrease on 1922-3. (Per cent.)	All Stations.†	Increase on 1922-3. (Per cent.)	Twenty-five Most Efficient.	Increase on 1922-3. (Per cent.)
1922-23	2·78	0	2·05	0	11·40	0	15·35	0
1923-24	2·67	4	2·00	2	11·95	5	16·00	4
1924-25	2·53	9	1·95	5	12·67	11	16·30	6
1925-26	2·40	14	1·80	12	13·14	15	17·50	14
1926-27	2·43	13	1·87	9	13·55	19	17·60	15
1927-28	2·16	22	1·68	18	14·55	28	18·70	22
1928-29	2·05	26	1·59	22	15·00	32	19·35	26

* Including public supply, railway, tramway and non-statutory undertakings.

† Based on calorific values recorded for the 25 stations.

TABLE XI—TOTAL SAVING IN FUEL THROUGH HIGHER OVERALL THERMAL EFFICIENCY OF STATIONS IN GREAT BRITAIN

Year.	Fuel Consumption (Tons).		Saving through Higher Thermal Efficiency (Tons).
	Actual.	On 1921-22 Basis.	
1922-23	6,788,306	7,620,000	831,694
1923-24	7,561,991	8,940,000	1,378,009
1924-25	8,001,687	9,860,000	1,858,313
1925-26	8,396,872	10,860,000	2,463,128
1926-27	8,795,722	11,770,000*	2,974,278
1927-28	9,177,594	13,200,000	4,022,406
1928-29	9,562,109	14,400,000	4,837,891
Total	58,284,281	76,650,000	18,365,719

* Correcting for lower calorific values of coal used.

POWER STATION EFFICIENCY IN GREAT BRITAIN

TABLE XII—Twenty-Five most efficient British Stations

Group (Output per Annun) Units.	1922-23 Station.	Fuel Con- sumption per Unit Generated. (lb. of coal.)	Overall Thermal Efficiency. (per cent.)	1928-29 Station.	Fuel Con- sumption per Unit Generated. (lb. of coal.)	Overall Thermal Efficiency. (per cent.)
A. Over 200 millions	Carville B. . . .	1·74	17·80	Barton	1·37	21·31
	Stuart St. . . .	1·96	14·80	North Tees	1·35	21·19
				Barking	1·57	20·61
				Carville	1·61	18·96
			Grove Road	1·69	18·95	
			Deptford East	1·63	18·58	
			Dalmarnock	1·71	18·41	
	Average 2 stations	1·84	16·26	Average 7 stations	1·55	19·98
B. 100-200 millions	Dunston	1·91	16·50	Lister Drive No. 3	1·48	19·77
	Glasgow	1·99	16·45	Bow	1·72	18·71
	Clyde Valley	2·34	14·56	Willesden	1·75	18·18
	Neepsend	2·30	13·10			
	Average 4 stations	2·13	15·10	Average 3 stations	1·63	18·95
C. 50-100 millions	North Tees	1·73	17·15	Padiham	1·33	21·35
	Radcliffe	1·80	15·85	Spondon	1·72	19·53
	Bradford	2·01	15·36	Agecroft	1·59	18·73
	Grove Road	2·08	15·00	Brimmsdown B. . . .	1·78	18·53
				Bankside	1·65	18·23
				Percival Lane	1·57	17·41
			Rotherham	1·92	16·97	
			Upper Boat	1·58	16·94	
			Ribble	1·73	16·88	
	Average 4 stations	1·88	15·90	Average 9 stations	1·65	18·30
D. 25-50 millions	Rotherham	1·98	16·70	Hartshead	1·58	20·53
	Stonebridge	2·24	14·90	Croydon	1·67	18·10
	Bolton	2·10	14·50	Longford	1·91	17·86
	Wimbledon	2·18	14·40	St. Helens	1·86	17·56
	Blackburn Meadows	1·98	14·32			
	Stockport	2·20	13·95			
	Tipton	2·92	13·90			
	Oldham	2·18	13·71			
	Willesden	2·30	13·71			
	Dundee	2·31	13·42			
	Brimmsdown	2·42	13·03			
		Average 11 stations	2·26	14·48	Average 4 stations	1·81
E. 10-25 millions	Hackney	2·05	15·40	Atherton	1·79	18·18
	Scottish Central	2·42	14·09	Gravesend	2·06	17·07
	Lincoln	2·32	13·98			
	St. Helens	2·53	13·40			
	Average 4 stations	2·33	14·18	Average 2 stations	1·92	17·50
A.—E.	Average 25 stations	2·05	15·35		1·59	19·35

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

fuel consumption per unit generated for all undertakings, including non-statutory undertakings, railway and tramway authorities, has fallen by 26 per cent since 1922-23, and the total saving in coal through such a reduction has been of the order of 18,366,000 tons in seven years, equivalent to 2,600,000 tons per annum. The capital value of such a saving alone is very considerable and gives the finest justification for adherence to a policy of high quality installations where a steady increase in overall thermal efficiency may be expected. Thus if the twenty-five most efficient stations are selected for special examination as being representative of the best modern practice and as affording a clue to the progress of modernization of re-equipment in electricity supply, the progress achieved in the post-war decade is little short of remarkable. The twenty-five most efficient stations had a fuel consumption in 1922-23 exactly equivalent to that of all stations in 1928-29, so that they were at least seven years ahead of the average standard ruling throughout the country. One can expect that, from 1929 onwards, fuel consumption in the country as a whole will parallel that already achieved in the twenty-five most efficient stations.

This conviction is strengthened by a comparison of the relative rates of increase in efficiency since 1922-23. Thus for the country as a whole the improvement recorded over seven years has been 31.5 per cent, compared with 26 per cent for the twenty-five most efficient generating stations. One can assume, therefore, that at the end of seven years a national average of about 20 per cent overall thermal efficiency may be reached, with a coal consumption of about 1.5 lb. per unit generated.

In the light of these statistics it is almost impossible to agree with the dictum that technically the electricity supply industry in this country has fallen seriously behind similar industries in other countries. If a direct comparison could be made between the twenty-five most efficient stations in Great Britain and the twenty-five most efficient stations in Germany or France or the United States, it might be seen that British practice had already achieved results superior to those indicated in other countries. Table XII., which illustrates the progress realized in the twenty-five most efficient stations over the period 1922-23 to 1928-29, supplies the detail necessary for elaboration of this statement. Thus we find five British stations with an overall thermal efficiency of over 20.5 per cent, compared with 17.8 per cent, the highest recorded in 1922-23. A number of stations working under unfavourable conditions should be added to this list—namely, Lister Drive No. 3, which has been operating at a thermal efficiency of 20.5 per cent, Agecroft at 20.46 per cent, and Grove Road at 20.15 per cent—so that eight stations at least in this country

POWER STATION EFFICIENCY AND CAPITAL VALUE

are averaging now an overall thermal efficiency of more than 20 per cent. Of these eight stations, only three belong to the super-power category—namely, Barking, Barton, and North Tees; while three stations, Agecroft, Padiham, and Hartshead, are by American and Continental standards comparatively small stations. The results achieved in Hartshead and in Padiham are specially noteworthy in this connection, Hartshead being equipped with two 7500 KW. turbo-generating sets, and Padiham with two units of 7500 KW. each and one of 15,625 KW. This shows that in Great Britain the highest results have been achieved with comparatively small units.

The trend is, however, towards the large generating station. Thus seven stations are listed in 1928–29 with an average output of 288,000,000 units—Barking with 400,000,000 units and Barton with 360,000,000 units being the largest in the country. In the year ending March 1924 only three stations were recorded for the whole country with an output in excess of 200,000,000 units each, but in 1928–29 eleven such stations were recorded with an average output of 281,000,000 units. Eleven stations averaged more than 100,000,000 units per annum and accounted for 1,930,000,000 units in the year ending March 1924, or 30.5 per cent of the output of all steam stations, but in 1928–29, twenty-five stations were listed with an output of 4,800,000,000 units, or 192,000,000 units per station, equivalent to 46.2 per cent of the output of all steam stations.

The capital value of such economies is very considerable and justifies in turn a high price for generating plant, the one question of importance being whether the increased capital expenditure required to ensure such economies is met by the savings realized as a result of such expenditure.

In view of the considerations indicated above, one can consider the price of electrical plant and apparatus either from the point of view of tonnage or of physical units. As we have indicated already, tonnage has ceased to have more than a relative significance in view of the rapid technical changes that have taken place, and it is true that the price per ton may be several times that of 1913 while the price per horse-power might be the same. We have no statistics giving the total tonnage corresponding to the production figures shown in Table IV. and are forced to rely, therefore, on export and import prices. These are given in Table XIII., where developments during the last twenty-four years are shown with reference to 1913. From 1904 to 1912, import prices of electrical machinery rose in a straight line, one interruption occurring in 1910. A fall took place in 1913, but the war years showed a rapid continuation of the upward movement. The boom years, 1919–1921, showed the culmination of this process, but since then there has been

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

TABLE XIII—IMPORT AND EXPORT PRICES OF ELECTRICAL MACHINERY
(Sterling per Ton)

Year.	Import Prices.	Export Prices.	Index (1913 = 100).	
			Import.	Export.
1904	71·4	68·6	61·7	80·0
1905	74·0	73·0	64·0	85·0
1906	78·8	70·5	68·2	82·2
1907	85·5	77·5	74·0	90·2
1908	91·0	73·5	78·8	85·6
1909	97·5	77·3	84·3	90·0
1910	93·4	74·6	80·7	87·0
1911	112·6	79·7	97·4	93·0
1912	128·9	82·7	111·6	96·5
1913	115·8	85·9	100·0	100·0
1914	128·9	87·5	111·6	101·9
1915	119·5	84·9	103·2	99·0
1916	134·2	85·7	116·0	100·0
1917	178·3	99·1	154·2	115·5
1918	251·4	99·0	217·0	115·2
1919	227·9	154·3	196·3	180·0
1920	254·4	224·0	220·0	201·0
1921	272·0	260·0	234·0	303·0
1922	257·0	246·0	222·0	286·0
1923	243·0	187·5	210·0	218·0
1924	254·0	167·0	219·7	195·0
1925	252·0	173·2	218·0	202·0
1926	269·0	172·2	233·0	200·5
1927	270·0	164·0	233·9	191·0
1928	264·0	162·4	228·2	189·0
1929 (9 months)	257·4	162·3	222·3	188·0

remarkably little change. The explanation for these developments may be found in the fact that prior to 1910 the machinery imported was the same as that made in Great Britain and covered every section of the industry. Since 1923 the position has been changed: imports constitute rather special types of machinery and a much higher percentage of small-capacity plant and apparatus, so that the resulting value per ton is much higher than would have been the case if the conditions ruling before the war had still continued unchanged.

In exports a very similar movement can be seen, with, however, a steadily widening gap between export prices and import prices. This would indicate that the industry was exporting on a definitely uneconomic basis before the war and was not sharing in the smaller and more lucrative sections of home demand with a high value per ton. During the war years a slight upward movement took place, with

PRICE COMPARISON BASED ON UNIT OF CAPACITY

recovery from 1923 onwards. Since that time, prices have moved steadily downwards and are now probably, measured on a horse-power basis, in the vicinity of the 1913 level. The value of these comparisons lies in the indication they give of changing policy and changing practice within the industry. This is the only significance which can be attached to the tonnage figures.

It is unusual for the consumer to purchase plant on a basis of weight; he prefers almost always the price per physical unit of capacity, either H.P. or K.V.A. To obtain some idea of developments in prices based purely on such units, a number of representative products was examined and a standard type chosen in each. The result is given in Table XIV., where 1920 is the standard of comparison. In

TABLE XIV—INDEX OF PRICES OF ELECTRICAL AND ALLIED PRODUCTS
(Based on Unit Capacity)
(1920 = 100)

Product.	Index.								
	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Turbines	100	66.0	49.9	43.0	43.0	43.0	43.0	40.0	34.1
Turbo-alternators	100	66.7	56.2	54.7	54.7	54.7	54.7	50.0	42.3
Condensing plant	100	66.7	40.0	30.0	30.0	30.0	30.0	30.0	30.7
Rotary converters	100	74.1	52.9	52.9	52.9	52.9	52.9	52.9	52.9
A.C. and D.C. generators	100	71.9	50.0	41.8	39.9	39.9	39.9	37.0	36.0
Dynamos and motors	100	64.5	44.9	40.4	40.4	40.4	40.4	40.0	30.0
Switchgear	100	74.0	64.8	64.8	64.8	64.8	64.8	64.8	58.3
Transformers	100	77.5	54.0	58.0	60.2	60.2	60.2	58.0	38.0
Meters and instruments	100	80.0	56.5	50.5	50.5	43.8	43.8	34.5	34.5
Weighted average	100	70.9	54.3	51.9	52.0	52.0	52.0	51.0	42.0

practically every product listed there has been a severe decline in price since 1921, the most marked changes taking place in dynamos and motors, condensers, A.C. and D.C. generators, meters, and instruments. The decreases that have taken place in the price-levels of those products are greater than in the wholesale prices of all commodities. The weighted average of the nine sections of the industry given shows that the movement in prices has coincided fairly closely with the movement in wholesale prices of all commodities, and in 1928 the electrical prices were actually below those ruling in the country as a whole. It is difficult in the light of this evidence to believe that any effort has been made to maintain prices at an unnaturally high level. It is impossible to bring those figures back to a 1913 basis owing to the lack of statistics bearing on the standard types considered. If,

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

however, the relation between the export prices per ton of electrical products in 1928, when compared with 1913, is taken as some indication, the 1928 price of electrical products based on 1913 would be about 120, compared with the wholesale price index of 140.

One indication of some importance which has a bearing on the course of prices in heavy electrical plant can be found in the returns of total capital expenditure incurred by public supply undertakings in this country. These statistics are published by the Electricity Commission and may be taken as accurate. In Table XV. we show :

- (1) The generating plant capacity without making allowance for withdrawal of D.C. plant since 1923 ;
- (2) The total capital expenditure on generating plant and machinery in the power stations, which is represented by boilers, condensers, turbo-alternators, transformers, rotary converters, motors, and switchgear ;
- (3) The total capital expenditure on distribution plant and machinery, which covers transformers, switchgear, rotary converters, and smaller plant ;
- (4) The total capital expenditure on meters used in distribution.

TABLE XV—CAPITAL EXPENDITURE ON ELECTRICAL PLANT AND MACHINERY

Year ending	Generating Plant Capacity. (Kilowatts.)	Total Capital Expenditure on Generating Plant and Machinery.		Total Capital Expenditure on Distribution Plant and Machinery.		Total Capital Expenditure on Meters.	
		Actual.	Per KW. of Generating Plant.	Actual.	Per KW. of Generating Plant.	Actual.	Per KW. of Generating Plant.
Mar. 31, 1923	3,091,179	£52,827,093	£17·1	£13,421,572	£4·35	£4,607,545	£1·49
.. 1925	3,745,025	64,369,124	17·1	15,040,970	4·02	5,569,466	1·48
.. 1926	4,452,174	69,684,385	15·6	17,165,249	3·86	6,246,782	1·40
.. 1927	4,750,635	72,795,651	15·3	19,619,346	4·14	7,107,001	1·49
Increase . .	1,659,456	£19,968,558	£12·1	£6,197,774	£3·73	£2,499,456	£1·50

The generating plant expenditure is perhaps the most reliable index owing to the fact that it corresponds directly to the generating plant capacity. Expenditure on distribution machinery based on kilowatts of generating plant may be affected by advance expenditure on distribution prior to the installation of additional plant in the generating stations, so that this section may go out of phase with the generating plant expenditure section. The same observation applied to meters. Since 1923 the cost per kilowatt of plant installed for all three groups together has fallen from £22·94 per kilowatt installed to £20·93, a fall of 9 per cent. This fall is greater than that recorded in Table XIV. for all products, and shows that the latter table

PRICES AND COSTS—GENERAL CONCLUSIONS

errs on the conservative side in its picture of declining prices. The expenditure on all three groups during the period 1923–27 was £17·33 per kilowatt of generating plant capacity installed compared with the figure of £22·94 already given—a decline in this case as high as 24 per cent compared with the average ruling up to March 31, 1923. The decline recorded between 1923 and 1927—namely, 9 per cent—is very similar to that registered by the export figures as shown in Table XIII., between 1923 and 1926, where the decline is 8 per cent. In the latter case this applies only to values per ton.

The main conclusions to be derived from this investigation of costs and prices are :

(1) The costs of production on an average have gone up 82 per cent measured in selling value of the product.

(2) Labour costs have increased by 116 per cent, but this has been offset by an increase in labour efficiency resulting from improved factory production. This increase in labour efficiency has served partly to make good the increase in taxation.

(3) The course of prices of the finished product, measured on a tonnage basis, is slightly greater than the increase in the costs of production measured in values, if the export figures are to be taken as an indication.

(4) The cost to the consumer of electrical and allied plant and machinery, as indicated by the capital expenditure of public supply undertakings on a basis of kilowatt capacity installed, has moved downwards in a straight line since 1922, and shows an even greater decline than the weighted average of all electrical products based on 1920. This would indicate that the prices paid by public supply undertakings are rather less than the prices ruling in the market, owing probably to the fact that the units purchased by the supply undertaking have a much higher capacity than those purchased by other types of consumer, so that they have been able to take advantage of technical changes in production which have tended to give a higher capacity per ton of electrical machinery produced and a lower price per kilowatt of power developed. They have benefited more from research and development in electrical manufacture than any other type of consumer.

III.—INTERNATIONAL COMPETITIVE EFFICIENCY

The question of importance remaining to be discussed is that of the international competitive efficiency of the industry. Such efficiency is governed by the costs of production, and especially wages, which can be fairly accurately compared among the main competing countries, and by more intangible elements, such as quality of production, reliability and economy in operation, and financial resources. We shall examine at this point the question of materials, wages, and taxation as the deciding factors in fixing differences in production costs.

Materials, as we have already shown, do not follow entirely the price quotations of the individual raw materials used in manufacture, owing to the fact that a very high proportion of materials as understood in electrical manufacture represents a

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

finished product passed on from one section of the factory to another higher up. A conservative estimate would fix such an estimate at not less than 70 per cent of all the materials used, and the deciding factor in the case of this 70 per cent must be that of wages paid in the factory itself. A comparison of the costs of material would be fairly sound as far as about 30 per cent of the total material costs are concerned, if the market quotations for the principal products are taken alone. For the remaining 70 per cent a comparison of wages paid in the industry would be more reliable. Many of the most expensive materials used in the electrical industry, such as copper, aluminium, and the non-ferrous metals generally, have an international market where there is no particular advantage accruing to any one country. The greatest differences occur in the prices of iron and steel products such as steel castings, steel forgings, dynamo sheet steel, tubes, pig-iron, and steel billets. The prices of such materials in Britain at the present time are decidedly higher than those quoted by European countries, and to the extent of this difference the British electrical manufacturer is handicapped. He may, of course, use a certain percentage of foreign materials for purely export work, and certain foreign buyers of plant require two quotations, one for the supply of British materials entirely, and one for the supply of a certain percentage of foreign and cheaper material. One would expect to find such a difference between British and foreign iron and steel products, largely through the circumstance that the product as used in electrical manufacture belongs to the highly finished sections of the iron and steel industry and is quoted at special prices. This observation applies, above all, to very large forgings and steel stampings, and the effect of high taxation and higher wages costs in Britain becomes cumulative as the product rises higher in the finished scale. It is difficult to determine with accuracy the real difference between prices paid by the electrical manufacturer in this country for iron and steel raw materials and the prices paid by his foreign competitor.

The second and most important factor is represented by wages. In a series of Tables, XVI.-XXI., we have collected information bearing on the average wages paid per hour in Great Britain, Germany, Switzerland, France, and Belgium. In the case of Britain, three sources were used—one bearing on a very large number of firms representative of practically the entire industry, the second giving results in one representative firm, and a third giving figures for eleven firms, with the average based, however, on adult male employment, excluding apprentices and other types of labour below the age of eighteen.

The first column in Table XVI. shows the movements in over-all labour costs; the third column shows developments in a firm employing a slightly more

COST OF MATERIALS—AVERAGE WAGES IN BRITAIN

skilled type of labour, while the fifth column bears on a higher type still. The increase from 1914 to 1928 is in the vicinity of 125 per cent for all employees, and 96 per cent for the more highly skilled grades. This in itself is evidence that the less skilled sections have been able to secure a higher relative rate of wages in 1928 than the skilled workers themselves. This is a development which is not peculiar to Great Britain. It is exactly paralleled in Germany, as Table XVII. shows. This table gives the result of an official wages survey carried out in Berlin by the German Federal Statistical Department. Each grade of employee has been rated

TABLE XVI—AVERAGE WAGES PAID IN ELECTRICAL AND ALLIED
ENGINEERING IN GREAT BRITAIN
(Pence per Hour)

Year.	Wages of All Employees.				Wages of Adult Males.	
	Entire Industry.		One Representative Firm.		Eleven Representative Firms.	
	(Pence per Hour.)	Index.	(Pence per Hour.)	Index.	(Pence per Hour.)	Index.
1914	6.50	100	6.53	100	8.50	100
1919	—	—	15.48	236	—	—
1920	17.00	262	19.62	300	—	—
1921	16.10	248	17.44	267	—	—
1922	13.30	204	13.82	212	—	—
1923	13.00	200	12.64	194	15.30	180
1924	13.80	212	13.65	209	16.35	193
1925	13.90	214	13.90	213	15.90	187
1926	14.00	216	14.30	218	16.20	191
1927	14.00	216	—	—	16.20	191
1928	14.60	225	—	—	16.60	196

TABLE XVII—AVERAGE WAGES PAID IN ELECTRICAL ENGINEERING
IN GERMANY*
(October 1928)

Classification.	Average Wage per Hour in Pence.					
	Time.	Index (1913 = 100).	Piecework.	Index (1913 = 100).	Total.	Index (1913 = 100).
Skilled (above 21 years of age) .	13.36	159	14.66	149	14.27	154.5
Semi-skilled " .	10.63	164	12.49	153	11.90	156.4
Unskilled " .	10.22	172	11.33	154	10.55	167.0
Female labour (above 18 years of age)	7.12	169	7.87	156	7.71	160.5
Total	10.70	166	11.60	155	11.29	158.7

* Statistisches Reichsamt.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

TABLE XVIII—AVERAGE WAGES PAID IN ENGINEERING INDUSTRY IN SWITZERLAND *
(1913 and 1928)

Classification.	Wages Paid.				Index (1913=100).
	Per Day (pence).		Per Hour (pence).§		
	1913.	1928.	1913.	1928.	
Foremen, etc.	84	154	9·3	19·2	207
Skilled and semi-skilled . . .	61	114	6·8	14·2	210
Unskilled	47	90	5·2	11·2	216
Female labour (above 18 years of age)	37	67	4·1	8·4	205
Labour (below 18 years of age) . . .	26	45	2·9	5·6	193
Total (omitting foremen and labour below 18 years of age)§§	52	91	5·8	11·5	200

* Statistics from Accident Insurance returns. § Taking 9 hours per day in 1913 and 8 hours in 1928.
§§ Adopting distribution given in German statistics.

TABLE XIX—AVERAGE WAGES PAID IN ELECTRICAL ENGINEERING IN FRANCE
(Paris Area)

A. In Francs per Hour

Classification.	1924.		1925.		1926.		1927.		1928.*	
	Time.	Piece.	Time.	Piece.	Time.	Piece.	Time.	Piece.	Time.	Piece.
Fitter (mechanical)	3·23	3·45	3·56	3·77	3·90	4·16	4·54	4·84	4·95	5·27
Machine-tool operator	3·73	3·81	3·95	4·04	4·32	4·41	4·97	—	5·94	—
Fitter (electrical)	3·36	3·49	3·57	3·74	3·88	4·04	4·48	4·81	4·90	5·24
Armature winder	3·29	3·38	3·48	3·65	3·73	4·06	4·42	4·78	4·82	5·21
Erector (factory)	3·13	3·56	3·34	3·54	3·65	4·05	4·32	4·65	4·70	5·05
„ (outside)	3·15	—	3·34	—	3·71	—	4·41	—	4·81	—
Turner	3·41	3·67	3·67	4·02	4·08	4·39	4·66	5·11	5·07	5·57
Finisher	3·80	3·95	4·10	4·21	4·44	4·52	5·20	—	5·67	—

B. In Pence per Hour

Fitter (mechanical)	9·1	9·7	8·4	8·8	6·2	6·5	8·8	9·2	9·6	10·1
Machine-tool operator	10·5	10·7	9·3	9·5	6·8	7·0	9·6	—	—	—
Fitter (electrical)	9·5	9·8	8·4	8·8	6·1	6·4	8·7	9·3	9·5	10·2
Armature winder	9·3	9·5	8·2	8·6	5·9	6·4	8·5	9·3	9·3	10·2
Erector (factory)	8·8	10·0	7·8	8·3	5·8	6·4	8·3	9·0	9·1	9·8
„ (outside)	8·9	—	7·8	—	5·9	—	8·7	—	9·5	—
Turner	9·6	10·4	8·6	9·4	6·4	6·9	9·0	9·9	9·8	10·8
Finisher	10·7	11·1	9·6	9·9	7·0	7·1	10·1	—	11·0	—

* Estimated on increases recorded for certain rates from 1927 to 1928.

INTERNATIONAL WAGES IN ELECTRICAL INDUSTRY

TABLE XX—AVERAGE WAGES PAID IN ENGINEERING INDUSTRY IN BELGIUM
(Pence per Hour)

Occupation.	Average Hourly Wages.	
	Jan. 1, 1928.	Nov. 1, 1928.
Lathe hands	6.60	7.25
Machinists	6.60	7.25
Iron founders	6.25	6.65
Moulders	6.95	7.70
Blacksmiths	7.35	8.10
Sheet-metal workers	7.35	8.10
Boiler makers	6.60	7.25
Riveters	5.60	6.15
Solderers	7.35	8.10
Enamel workers	5.60	6.15
Plumbers	5.95	8.15
Armature winders	5.65	6.30
Electricians	5.95	7.70
Copper founders	8.20	8.80

TABLE XXI—INTERNATIONAL COMPARISON OF WAGES IN ELECTRICAL INDUSTRY
(Pence per Hour)

Country.	1913.	Index (Great Britain=100).	1928.	Index (Great Britain=100).
Great Britain	6.50	100	14.60	100
Germany	7.10	109	11.29	77
France	6.60	102	8.70	59
Belgium	—	—	6.50	44
Switzerland	5.80	89	10.50	72

in accordance with the percentage of total employment, with the result that the average given in the fifth column with the total at the foot is the true average wage ruling in the industry, and it should be compared with a figure intermediate between 14.6d. and 16.6d. per hour in the British table. To avoid all possibility of criticism, we have compared in Table XXI. the German figure of 11.29d. with the British figure of 14.60d., but it should be noted that such a comparison is unduly favourable to Germany. The German statistics given show an increase of only 59 per cent over 1913 compared with the British increase of 125 per cent, unskilled and female labour showing much the greatest increase, skilled workers being lowest from this point of view. It should be noted that the average wage paid in Germany to the

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

skilled worker is less than the average paid to all employees, skilled, unskilled, female and youthful labour, in the British industry.

In the case of Switzerland, we have taken the statistics in connection with accident insurance as being more representative of the real wages paid than standard rates for certain grades. The average given here is about 11·5*d.* per hour, the rating between the various sections being based on that obtaining in Germany. Owing, however, to the high percentage of female labour employed in Swiss industry the real average wage is probably in the vicinity of 10·5*d.*, and this has been adopted. Swiss wages show much the same increase over 1913 figures as the British, unskilled labour again enjoying the greatest relative advance. Detailed statistics are available for the Paris area in France, but as no general average has been established, one must rely on an estimate for unskilled and female labour sufficient to allow us to create an average for the entire industry. Unskilled labour, which is not given in the table, was paid in 1928 almost half the wage of a turner—namely, about 4½*d.* per hour. 1927 constitutes perhaps the only reliable year, owing to the fact that the preceding years were influenced by fluctuations in the value of the franc and during that period inflation decided industrial and financial activity. Since 1928 a new period of inflation has probably set in as a result of the policy of the Bank of France in importing immense stocks of gold and increasing the circulation in direct ratio to the gold bullion. One would expect, therefore, prices and wages in 1929 to show a further considerable increase over 1927 and 1928. It is remarkable, however, that the highest wage paid to skilled workers in France is now only equivalent to the wage paid to unskilled workers in Germany and Britain, and the general average, which may be given as about 8·7*d.*, showed an increase of only 33 per cent over the 1911 figures for a representative number of grades.

The Belgian figures are even smaller as a result of the same factors aggravated by the action of the Belgian Government in deliberately under-valuing the franc. Such a movement has brought down very considerably Belgian costs of production, as represented by wages and taxation, and allowed Belgian firms to quote wholly uneconomic prices in foreign competition. In Table XXI. a direct comparison is made. From it can be seen that British wages in 1928 were more than twice the Belgian, almost twice the French, 30 per cent above the German, and almost 40 per cent above the Swiss. A comparison with 1913, when wages were much the same in all countries, suffices to show how greatly the labour situation has moved against this country. The industry, to remain in existence at all, will have to increase its efficiency to a much higher level than any other ruling in any country in Europe.

An international comparison of wages and labour costs would be incomplete

WAGE ANALYSIS—INTERNATIONAL HOURS OF LABOUR

without some indication of the position with reference to hours of labour. Thus, the 47-hour week rules in British industry—in other words, after the 47th hour, an addition must be made to the standard wage for overtime equivalent to 50 per cent. This means that, in the event of very large contracts being accepted requiring continuous operation and a very high manufacturing speed, an additional cost must be calculated to cover this matter of overtime. In other countries, the 48-hour week is not so rigidly observed, and we give in Table XXII. the results of an investiga-

TABLE XXII—HOURS OF LABOUR: ACTUAL WORKING HOURS IN METAL WORKING AND ENGINEERING

Country.	Number of Factories covered.	Number of Workers.	Per cent of Workers who were Working.						
			On Short Time.	In full-time Factories, counting Overtime Work.					
				Under 48 Hours.	48 Hours.	Over 48 but not over 51 Hours.	Over 51 but not over 54 Hours.	Over 54 but not over 60 Hours.	Over 60 Hours.
Belgium . . .	273	28,846	—	8.2	86.4	1.4	2.9	1.0	0.1
Denmark . . .	3,087	33,489	0.9	0.2	94.1	2.3	1.8	0.6	—
Germany . . .	19,698	1,525,591	9.4	1.8	54.5	12.5	16.8	4.8	0.2
Estonia . . .	302	4,604	0.6	62.0	35.1	1.1	0.2	0.6	0.4
Latvia . . .	—	3,000	—	60.0	25.0	8.0	4.0	2.0	1.0
Memel Territory	2	179	—	—	100.0	—	—	—	—
Holland . . .	263	46,437	0.1	0.4	56.5	34.2	7.7	1.1	—
Palestine . . .	44	645	—	11.0	55.8	2.3	—	20.8	10.1
Poland . . .	106	61,373	1.6	64.5	10.1	4.7	4.9	10.9	3.3
Sweden . . .	824	80,276	3.4	4.7	78.8	3.8	3.3	5.3	0.8
Switzerland . . .	1,900	86,000	0.1	0.4	57.9	8.7	30.4	2.3	0.2
Spain . . .	1	900	11.1	3.3	85.6	—	—	—	—
South-West Africa . . .	21	431	—	—	71.9	0.7	12.3	10.0	5.1
Czecho-Slovakia . . .	21	6,974	2.1	—	92.8	1.1	0.5	2.6	0.9
Hungary . . .	—	26,827	—	21.6	54.3	6.9	1.2	12.6	3.4
Total . . .	26,542	1,905,572	7.8	4.5	55.5	11.7	15.4	4.8	0.3

tion carried out in October 1928 by the International Federation of Trade Unions, published in its official organ, *The International Trade Union Movement*, Amsterdam, February 1929. Great Britain has been omitted, largely owing to the fact that the entire metal-working and engineering industry in this country would come under the category of being employed either under 48 hours a week or 48 hours. It is interesting to note that the countries exceeding consistently the 48-hour week convention are, in order of excess, Switzerland, Holland, Germany and Hungary

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

among European countries. Actually 41·6 per cent of all Swiss employees are working in excess of 48 hours per week, the greatest excess taking place between 51 and 54 hours. It is significant to note, in this connection, that in Switzerland the 48-hours week can be exceeded for economic considerations. Among such considerations may be listed: work done in the public interest, for the national security, for the development of exports, and for the countering of foreign competition at home. The result has been that practically the entire Swiss engineering industry is now on a permissible maximum of 52 hours. Beyond 52 hours, overtime must be paid at the rate of 25 per cent, not of 50 per cent as in this country. This development has more bearing on competitive strength than on competitive efficiency, but for purposes of propaganda Swiss industrialists have asserted, when tendering for contracts in this country, that they adhere to the 48-hour week. They may adhere to it in theory, but practice, as the examination shows, is quite different.

It is obvious, however, that it would be inadvisable for British industry to abandon its present hours of labour in favour of something definitely reactionary. The industry has adjusted itself to the conditions imposed by such a limitation, and it is operating with a fair level of efficiency on such a basis, but recognition should be made of the fact that Great Britain alone among the main competing countries is adhering to the exact letter of the 47- or 48-hour week.

A third factor is represented by taxation. Britain has always been the most heavily taxed country in the world—the statistics given in Table XXIII. prove

TABLE XXIII—TAXATION (NATIONAL AND LOCAL) IN 1913 AND 1927

Country.	Total Taxation.				Per Head of Population (in Sterling).			
	In National Currency.		In Sterling.		1913.	Index Great Britain = 100.	1927.	Index Great Britain = 100.
	1913.	1927.	1913.	1927.				
Great Britain	£251,500,000	£825,900,000	£251,500,000	£825,900,000	£6 2 0	100	£18 16 0	100
U.S.A.	\$1,550,000,000	\$6,636,600,000*	£319,000,000	£1,365,000,000	£3 4 0	57	£11 18 0	58
Germany	M. 5,445,800 000	M. 10,626,400,000	£266,000,000	£520,000,000	£3 18 0	64	£8 4 0	44
France	5,141,000,000 frs.	42,684,600,000 frs.*	£204,000,000	£283,700,000	£5 3 0	85	£6 19 0	37
Switzerland	267,500,000 frs.	789,700,000 frs.	£10,600,000	£31,300,000	£2 16 0	46	£7 16 0	42
Belgium	467,000,000 frs.	7,730,635,000 frs.	£18,500,000	£44,200,000	£2 9 0	41	£5 12 0	30
Italy	2,600,000,000 lire	19,520,200,000 lire†	£103,000,000	£156,200,000	£2 16 6	46	£4 0 0	21

* 1926.

† 1925.

that quite clearly—and the influence of such taxation is not limited to one product alone. It is cumulative and bears most heavily on the industries highest in the list of manufacture and, above all, on electrical engineering. In 1913 Belgian taxation was only 41 per cent of British, Swiss taxation was 46 per cent, German

INTERNATIONAL TAXATION—COST COMPARISONS

taxation 64 per cent, and French 85 per cent. The differences, even in that year, were striking enough, but developments since then have intensified the burden borne by Britain and widened the gap between it and other competing countries. Thus, in 1927, Belgian taxation was only 30 per cent of British, Swiss 42 per cent, French 37 per cent, and German 34 per cent, the average for all the countries listed being not much more than 50 per cent. In other words, the British manufacturer is paying, per unit of output, more than twice the amount of taxation paid by foreign manufacturers, and this element enters every item of cost from materials onwards.

In Table XXIV. we have shown the position in the costs of production as between Great Britain on the one hand, and Germany, France, Switzerland and Belgium on the other, in 1913 and 1928. German wages in 1913 have been taken

TABLE XXIV—INTERNATIONAL COMPARISON OF COSTS OF PRODUCTION

1913					
Classification.	Great Britain.	Germany.	France.	Switzerland.	Belgium.
Materials.	48·3	48·3	49·0	44·5	—
Labour	26·3	26·6	26·6	23·4	—
Factory and commercial expenses	23·9	23·9	23·9	23·9	—
Taxation	1·5	0·9	1·3	0·7	—
Total	100·0	99·7	100·8	92·5	—
1928					
Classification.	Great Britain.	Germany.	France.	Switzerland.	Belgium.
Materials.	42·5	35·6	30·3	34·1	25·9
Labour	28·5	22·0	16·8	20·5	12·6
Factory and commercial expenses	24·3	24·3	24·3	24·3	24·3
Taxation	4·7	2·0	1·7	2·0	1·4
Total	100·0	83·9	73·1	80·9	64·2

as practically the same as Britain, allowance being made for differences in types of labour employed. In 1913 the item "factory and commercial expenses" has been retained unchanged through all five countries, and for 70 per cent of materials costs the differences in labour have been used, the remaining 30 per cent being retained unchanged. The Table gives a fairly accurate picture of the costs situation in all five countries. German costs are now only 84 per cent of British, French costs 73 per cent, Swiss costs 81 per cent, and Belgian costs 64 per cent, compared with a very close approximation between all countries in 1913.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

The meaning of these figures is this : British selling-prices, working on this cost comparison alone, would require to be 20 per cent above the German, almost 40 per cent above the French, 25 per cent above the Swiss and 50 per cent above the Belgian, before the British manufacturer could hope to earn the same ratio of profit. Recent quotations have shown that some such difference does exist. One would expect, therefore, in view of these statistics, that the competitive strength of the industry in international competition would not be very great, and that it would be losing ground very rapidly, even in the home market; but it has already been shown, with reference both to exports and production for home purposes, that the industry is not only meeting competition but is actually increasing its hold. It is stronger now than it has ever been, so that one must look to factors other than prices for the success that has been achieved. These factors are to be found, above all, in quality and efficiency of production, and the technical changes in the industry have been such as to favour quality as against mass production.

Some idea of the technical changes that have taken place may be found in a statement made by Mr. L. P. Alford, of the American Engineering Council :

“The advance in the design, construction, and operation of large steam central stations has been principally along three lines: (1) larger generating units using steam turbines exclusively as prime movers and larger boilers; (2) higher steam pressures and superheat temperatures; and (3) greater use of waste-heat recovery apparatus. To these might be added improvements in all auxiliary machinery to the advantage of the over-all efficiency of operation. A rough idea of the advance in efficiency may be had from the fact that for one station, generating from 20,000 to 100,000 kilowatts, the present rate of coal consumption is about 2 pounds per kilowatt-hour as against about 3.5 pounds per kilowatt-hour ten years ago. Heat economies have also been introduced all the way from the furnaces to the last expansion stage of the turbine.

“Higher efficiencies than now obtained by the best, about 13,000 B.Th.U. per kilowatt-hour, are expected and can be produced; but not a great deal higher for the best all-round results. The trend at present is rather to raise the general average of power generation all over the country than to construct occasional units of exceptional efficiency, leaving the majority of power-generating plants in their present condition.

“To-day central station pressures are to be found in three ranges for modern installations: (1) a range around 400 pounds per square inch; (2) a range from 550 to 750 pounds; (3) a range from 1000 to 1400 pounds. The greatest activity at present is in the first and third ranges, the intermediate one being proportionately neglected. The choice between these two, the basis of selection, is partly a matter of load, but more a matter of coal prices. For a cheap coal with a small average load, the 400-pound range is preferred; with a higher-priced coal and a high average load, the 1000-pound range is preferred; both may be found in the same station. Thus, in modern existing stations, with units already in use operating at 400 pounds or less, 1000-pound boilers can be added and high-pressure turbines can use this steam, exhausting it into the lower-pressure steam mains, after re-heating for the lower-pressure turbines.

TECHNICAL CHANGES IN LARGE STEAM STATIONS

"Temperatures are now limited to about 750° F. because as yet the metallurgists have not been able to provide a steel at a usable price that is perfectly reliable for higher temperatures. The tendency, however, is upward, and 800° and 850° F. are already in use to a limited extent.

"There is also a tendency towards larger boiler units; some in operation to-day are good for over 400,000 pounds of steam per boiler per hour. Others now under erection have a specified capacity of 1,000,000 pounds of steam per boiler per hour. It seems probable that the practice will soon be to provide each turbine with its own boiler, no matter how large the turbine.

"Interconnection of stations is also extending, making it unnecessary to have both peak-load and base-load units in one and the same station, by substituting base-load stations and peak-load stations. Interconnection also improves the average load through the "diversity factor," peak-loads on one part of a chain not occurring at the same time as on another part. This is noticeable in one district, for instance, where a mine and colliery load is just going off at the same time that the electric traction load of a near-by city is just rising to its peak in the early evening.

"In fuel, the outstanding change of the past few years has been the growth of pulverized coal installations. The extent of the use of fuel in this form is indicated by the fact that at the present time forty public utilities in the United States are either partially or fully operated with pulverized coal, the aggregate generator capacity so fired being 2,200,000 kilowatts. In addition, there are now under construction five new plants and extensions to two old plants having together a total capacity of 440,000 kilowatts, all of which will be operated with pulverized coal. The significance of these figures can better be appreciated from the following tabulation:

	Number.	Capacity, kilowatts.
Installations in operation	40	2,200,000
Installations under construction	7	440,000
Total	47	2,540,000
Installations in operation and under construction entirely operated with pulverized coal	27	1,700,000
Plants with 40,000 kilowatts capacity or more operated with pulverized coal	27	2,250,000"

He is dealing specifically with practice in the large power station. The developments he outlines can be closely paralleled in Great Britain and have now entered into the range of international practice, and it is significant that British industry should have been in the forefront of technical progress in this matter. Through the application of research and through the expenditure of large sums on development and experiment, the industry has been able to initiate important changes and important modifications in design and manufacture. The result is that it has been not merely creating a high-quality product, but it has also been among the first to meet the requirements of the consumer as represented by a large public supply undertaking. It has also been particularly active in connection with very large power and railway electrification schemes. It is on the basis of the reputation acquired during the post-war years as well as on the experience in handling compli-

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

cated and difficult contracts that the industry has developed a large export trade and maintained its hold on the home market.

IV.—CAPITALIZATION AND EARNING CAPACITY

It is difficult to establish accurately the value of the total capital invested in electrical manufacture, owing to the fact that a number of firms are not entirely electrical in their activities, but a selection has been made of thirteen firms covering about 90 per cent of the output of electrical and allied machinery alone. Cable firms have been omitted, since the main interest of this monograph lies more in an examination of electrical engineering proper than of electrical apparatus and cables. Two of the firms listed, namely, the General Electric Co., Ltd. and Johnson & Phillips, are cable manufacturers as well as manufacturers of electrical machinery, while Mather & Platt and the Brush Electrical Engineering Company are dependent for a proportion of their profit-earning capacity on products outside of the electrical range. Table XXVIII. illustrates the position since 1925—first of all, for the entire thirteen firms and, secondly, for eleven firms, omitting Mather & Platt and the Brush Electrical Engineering Company. The position as discussed in the latter is probably more representative of the earning capacity of the industry than in the former. No deduction has been made from net profits for special reserves and special allocations, with the result that the percentage of income to total capital cannot be taken as representative of the dividend actually paid on earning shares. It is inadvisable to isolate the ordinary shares from other forms of capital and establish a ratio between net profits and the total of such capital, since it is possible for a firm to have a very small ordinary share capital issued in order to secure control among a limited number of holders quite apart from the capital required for ordinary manufacturing purposes. The addition of preferred shares, debentures and reserves, which are invested as a rule in the manufacturing plant and machinery, gives a much more reliable idea of the real capital used in production, and it corresponds, to some extent, to the total capital expenditure returns in electricity supply.

The electrical manufacturing industry is unusual inasmuch as it has a very high proportion of debentures and preferred shares to the total of ordinary share capital employed, and such fixed-interest-bearing capital has increased the value of the surplus available for ordinary share dividends. In 1925 the gross earning capacity of the industry was about 9.65 per cent of the total working capital, and in 1928 it had fallen to 8 per cent. Including eleven firms alone, the corresponding percentages were 9.35 and 7.70. Such a return cannot be considered as satisfactory,

FINANCIAL POSITION OF THE ELECTRICAL INDUSTRY

TABLE XXV—FINANCIAL POSITION OF ELECTRICAL PLANT MANUFACTURERS

*A. Thirteen Firms**

Year.	Ordinary Share Capital.	Preferred Share Capital.	Debentures.	General Reserve.	Total Capital.
1925	£10,666,000	£8,002,000	£8,547,000	£3,165,000	£30,380,000
1926	10,666,000	8,002,000	8,537,000	3,445,000	30,650,000
1927	10,666,000	8,012,000	8,527,000	3,732,000	30,937,000
1928	10,666,000	8,012,000	8,517,000	4,015,000	31,210,000
	Total Prior Charges Paid.	Net Profits.	Total of Prior Charges and Net Profit.	Percentages of Total Capital.	
1925	£1,109,000	£1,811,000	£2,920,000	9·65	
1926	1,049,000	1,478,000	2,527,000	8·25	
1927	1,049,000	1,398,000	2,447,000	7·92	
1928	1,048,000	1,447,000	2,495,000	8·00	

B. Eleven Firms.†

Year.	Ordinary Share Capital.	Preferred Share Capital.	Debentures.	General Reserve.	Total Capital.
1925	£8,826,000	£7,962,000	£8,272,000	£2,681,000	£27,741,000
1926	8,826,000	7,962,000	8,262,000	2,955,000	28,005,000
1927	8,826,000	7,962,000	8,252,000	3,236,000	28,276,000
1928	8,826,000	7,962,000	8,242,000	3,515,000	28,545,000
	Total Prior Charges Paid.‡	Net Profits.	Total of Prior Charges and Net Profit.	Percentages of Total Capital.	
1925	£1,094,000	£1,474,000	£2,568,000	9·35	
1926	1,035,000	1,158,000	2,193,000	7·80	
1927	1,034,000	1,102,000	2,136,000	7·51	
1928	1,033,000	1,140,000	2,173,000	7·70	

* The firms represented are—

Composite—General Electric Co., Ltd., Metropolitan-Vickers Electrical Co., Ltd., British Thomson-Houston Co., Ltd., English Electric Co.

Rotary Converters—Mather & Platt Ltd., Bruce Peebles & Co., Ltd.

Large Dynamos and Motors—Lancashire Dynamo & Motor Co., Ltd.

Transformers—Johnson & Phillips, Ltd., Ferranti, Ltd., British Electric Transformer Co., Ltd., Brush Electrical Engineering Co., Ltd.

Switchgear—A. Reyrolle & Co., Ltd., Ferguson, Pailin, Ltd.

† Omitting Mather & Platt, Ltd., and Brush Electrical Engineering Co., Ltd.

‡ Without allowance for sinking fund but including dividends on preferred shares.

even although it shows that the industry is in a much healthier position than other basic industries which have been operating at a loss since the conclusion of the war. The electrical industry before the war was affected so adversely by foreign com-

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

petition that it was unable to earn a reasonable return on the capital invested, with the result that it was considered one of the most speculative from the investor's point of view. It was in a weak position from the point of view both of capital resources and of actual capital investment, and its competitive efficiency suffered accordingly. A return of 7·7 per cent does not provide a sufficient surplus for important development or research work, and the industry is now working on a much narrower margin than even in 1924.

It is also significant that, in five years, the electrical manufacturers listed above should have been able to increase their general reserve by slightly less than £1,000,000 as compared with a total capital of £31,000,000. This would indicate, among other things, that the industry is becoming seriously under-capitalized and is suffering from its inability to enter a steady rate of interest on the capital employed. Yet, during this period, the turnover has very considerably increased. Table IV., which corresponds roughly with any tendency in the capital invested, as shown above, records an increase of 10 per cent since 1924 even during a period of falling prices, while the number of employees in electrical engineering, taken as a whole, rose from 60,850 at the end of 1923 to 79,050 at the end of 1927, and is probably now in excess of 84,000. Measured by tonnage of output, a similar expansion has taken place, production of electrical and allied machinery amounting to about 84,000 tons in 1923 and 140,000 tons in 1927, an increase in volume and weight of output of almost 67 per cent. It should be noted, of course, that the entire industry, engineering, cable making, and apparatus manufacture, employs more than 180,000 workers with an estimating tonnage output of about 450,000 tons.

Thus, one can state the position briefly as follows :

- (1) An increase in volume of output of 67 per cent.
- (2) An increase in labour of 38 per cent.
- (3) An increase in the value of turnover of 22 per cent.
- (4) A decrease in the net return of 18 per cent.

If no compensating factors had been in existence, the result of such movements taken together would have meant bankruptcy, but, as we have already partly shown, the industry has made good many of these difficulties—first of all, through higher labour efficiency resulting from the use of better machinery ; secondly, through the realization of a better manufacturing load in the factory with reduction in overhead expenditure ; thirdly, through improvement in the administration and internal organization of the manufacturing firms themselves.

The table of capitalization shows that the return to the industry is undoubtedly

THE PROFIT-EARNING CAPACITY OF THE INDUSTRY

unsatisfactory at the present time. It has become so low that it is weakening enterprise, and the industry is in danger of being deprived of those liquid financial resources which are necessary to handle large contracts at home and abroad. The capacity of the manufacturer to embark on large research and development expenditure has been limited through the necessity for excessive economies resulting from the competitive situation at home and abroad, and only a period of stable prices will ensure the realization of a more powerful competitive activity through the use of adequate financial reserves. The price declines that have taken place in the industry per unit of output are rather greater even than the economies effected, although they have been considerable, the decline in the net yield on the capital employed proving this quite clearly. This consideration ought to be clear before the mind when such indicators as Stock Exchange quotations are studied. It has been suggested that Stock Exchange quotations afford a reliable indication of profit-earning capacity or the profit-earning situation in industry, but recent movements have shown that such quotations are only useful as a thermometer to gauge the temperature of speculation and have no other significance whatever. The electrical manufacturers, to earn sufficient profits to justify present quotations, would require to double their output with stable prices, would require to double their capital turnover, and would require to double their net yield.

As Table V. shows, production in electrical and allied machinery alone has increased since 1920, but the fall in prices has neutralized to some extent the increase in volume of output. It is true, of course, that the whole of this period since 1921 has been a period of unequalled trade depression, so that the demand from industry has been sub-normal. It is also true that the reorganization of electricity supply, which was undertaken in 1919 and onwards, has been delayed owing to the inherent difficulty in ensuring effective co-ordination among the supply undertakings, and the two years' initial preparation since the Electricity Supply Act of 1926 have served to retard the expansion of the demand for power plant and equipment. One would expect, therefore, that from 1929 onwards there would be a considerable increase in production, but the statistics since 1923 show that volume has experienced a very considerable expansion indeed, and it is essential, therefore, that the industry should be able to avoid excessive competition and maintain its prices at a satisfactory level. In other words, the profit-earning capacity of the industry does not depend on anticipation on the Stock Exchange, but on the capacity of the firms within the industry to avoid uneconomic competition and maintain some stability of prices.

The rate of capital turnover in the industry—*i.e.* the ratio of annual output to the capital invested as represented by ordinary and preferred shares only—was, for

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

all the groups recorded in Table III., 1.30 in 1913 and 1.42 in 1928, so that in 1913 it took 9.2 months for production to equal the capital, and in 1928, 8.5 months. Including debentures, capital turnover improved from .79 in 1913 to .96 in 1928. The result of this is that, measured on turnover, the net yield of 7.70 on capital invested as recorded in Table XXV. for 1928 was only 5.45, if the percentage of net earnings to the total working capital remaining can be taken as representative of the electrical engineering industry. In reality, for the eleven firms mentioned, the net profit was actually not more than 3.5 per cent of the turnover, owing to the fact that a number of these firms was engaged in manufacturing also smaller apparatus, such as meters, instruments, domestic apparatus, lamps, accessories, and supply material generally, which have a rapid rate of capital turnover. The significance of this is that a fall of 5.45 per cent in prices, without any compensating factors being present, would eliminate net profits in the industry entirely; the industry is in a less powerful position than it was in 1924, when the net yield on turnover was about 6.5 per cent. From such a net yield, deduction must be made for special reserves, special depreciation, and special investments necessary to the fulfilment of contracts on which advance payments are not available, and the margin resulting is, as a consequence, remarkably low.

The rate of capital turnover has undoubtedly improved since 1913, a development which might have been expected in view of the evidence given above. The accusation that over-capitalization has been a factor retarding progress and making for excessive prices, breaks down before these facts. Productive capacity, as measured in capital expenditure per unit, is very much less now than it was in 1913, but there has been an improvement in the unit itself, so that the industry enjoys a higher productive capacity than in 1913 and the use of more efficient machinery at a lower operating cost per unit of output. Rationalization aims, above all, at realizing this position, so that, judging by this test, the industry is probably one of the most progressive in this country.

A characteristic of electrical manufacture has been the emergence of the composite firm dealing with a wide variety of products. It is unnecessary at this stage to examine the theoretical justification for the development of such a type. In the introduction of this monograph, we have indicated certain factors which rendered necessary the emergence of the very large undertaking. The experience of the United States is of special interest in this connection. The expansion of electrical manufacture in the United States has been of such a nature that the large manufacturing concern has almost inevitably emerged. Thus one company, the General Electric Company, supplies about 52 per cent of the national output of generators

CO-OPERATION AMONG MANUFACTURERS

and transformers, 42 per cent of motors, 30 per cent of rotary converters, about 38 per cent of control and switchgear, 31 per cent of meters, 48 per cent of lamps and vacuum tubes, etc., and 33 per cent of electric locomotives. The General Electric and the Westinghouse Companies between them account for about 77 per cent of the national production of generators and transformers, 70 per cent of motors, 61 per cent of control apparatus and meters, 47 per cent of switchboards and switchgear generally, and 40 per cent of fractional horse-power motors, while, in turbo-generators taken as a whole, the General Electric Company has been responsible for about 64 per cent of all the turbo-generators installed in American power stations, and the Westinghouse Company for 25 per cent.

In Great Britain, production has not been concentrated so definitely in the large firm, but, as a result of amalgamations and mergers which have taken place during the last few years, three groups of firms, each capable of dealing with an entire power plant installation or an entire transmission or distribution system or an entire railway electrification scheme or a large industrial electrification project, have now evolved, and these three groups employ about 58,000 workers, with an output not far short of £30,000,000. In heavy plant alone, they have been responsible for about 60 per cent of the national output, and in all products, including lamps and cables, for about 35 per cent. If cable firms are included, where about eighteen firms account for almost the entire national production, twenty-one firms or groups of firms account now for more than 61 per cent of the entire national production of electrical and allied machinery and apparatus of all kinds. The result of such amalgamations has been, of course, the development of a very strong export trade position and the maintenance of export shipments in the face of the most determined competition.

Apart from the creation of composite firms, specialist firms engaged in smaller lines of manufacture have also come together, notably in the production of heating and cooking apparatus, of switchgear and of industrial motors. During the last eighteen months, ten firms have come together to form three groups, each with more efficient productive capacity and stronger resources as the result of such amalgamation. These firms have now extended their sales organizations, especially at home, and are widening very rapidly their export activities and their export connections.

A third development of interest has lain in the extension of manufacture by what has been hitherto regarded as the specialist firm so that it may now be regarded as, to some extent, composite. This observation applies to firms which specialize in transformers, in turbo-generators, and in industrial motors. They have

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

tended to include a number of other activities which might not only increase their earning capacity but improve their manufacturing load. Such a development has had an opposite effect to that represented by large amalgamations or mergers among composite firms themselves and the close association of specialist firms. In the latter, developments have been dominated by the idea that competition should be held in check and greater resources should be brought into existence not only to meet competition but also to develop selling resources. The effect of the former is to intensify competition and weaken the resources available for the prosecution of trade to the extent that prices are forced downwards through the entrance of new producers.

How far the industry can allow such an increase in its productive capacity and yet yield a satisfactory return on capital invested to those already manufacturing is a matter of doubt. The industry has not until recently been able to attract new capital to any great extent. It is probably one of the most difficult in Britain for a new undertaking to enter into and compete successfully, so co-operation between manufacturers has, on the whole, been more successful in it than in almost any other industry. Such co-operation served in no small measure to stabilize market conditions even against the most determined competition from foreign manufacturers and against the criticism that has been directed against it on the part of authorities who are consumers of foreign electrical machinery and apparatus. It is sufficient in this connection to quote from a previous publication of this Association.

“ The movement towards the larger producers, or association of producers, which might take the form of trusts, combines or trade associations with considerable executive powers as far as prices and manufacturing conditions were concerned, must be regarded as an inevitable development under modern conditions—in the direct line of evolution towards better economic and social conditions in the modern State. The mentality which rejoiced in the sacrifice of our great industries on the altar of low prices, low wages and a low standard of life, now finds little sympathy among those who have devoted study to the relations between industry and the State. A return to the conditions existing before the war, with unrestricted competition at home and abroad forcing industry down to a permanent starvation level, appears now unthinkable. Examination of the forces against which the electrical industry in this country has even now to struggle in its effort to maintain a sound position in export markets and avoid depression at home, should be sufficient to show that a return to the isolated manufacturer competing against other manufacturers at home and foreign competitors as well would mean suicide at once. Conditions have changed so radically that even an experiment on the old lines might provoke a dangerous crisis.

“ The justification of what is popularly known as the ‘ring’ or ‘trust’ or ‘combine’ lies exactly in the fact that it came naturally into existence to meet a certain situation—in the case of Britain imposed from without—and that no reasonable alternative has yet been found for it.

“ If we look even casually at the international industrial and trade complex, we can only see our competitors creating, developing, arranging their forces to obtain the utmost unity of control. The free play of economic forces has become a myth, and it is a condition of our existence as a great industrial

THE ASSOCIATION OF PRODUCERS—CONCLUSIONS

nation that we, in turn, should abandon all idea of individual liberty in trade without a guiding or controlling motive, and arrange our forces even as thoroughly as Germany, the United States, or France. In practically every industry, manufacturers have come or are coming together to discuss reasonable conditions of production and sale.

“The main motive inspiring the formation of vertical combines, where a number of manufacturers engaged in various industries feeding into each other from the raw material stages onwards to the most highly finished product (the best example being found in the series—coal, iron ore, pig-iron, steel ingots, rolling mills, machinery and electrical apparatus) came together in one group, was undoubtedly the realization of stable conditions both in production and price. The iron and steel firm, for example, required a sure and steady supply of raw materials on the one hand, and a certain outlet for much of its production on the other. In the same way, the horizontal trust meant a combination of producers in one industry, or even a branch of one industry, alone, to control national production, and, through the reality of such control, ensure stable price and market conditions. In the same way again, the association of manufacturing firms in one industry without the direct formation of a trust was conceived as the only possible method of securing some form of stable price conditions without sacrifice of individual initiative. . . .

“The introduction of stable manufacturing and price conditions into industry must be regarded as a necessary stage in the evolution towards a more prosperous state of trade and of material existence as a whole. The main weakness of the basic industries, such as engineering and electrical manufacture, has been that concerted action in their case at least has not yet been sufficiently strong to allow them to avoid being victimized by the distributor and consumer in the matter of price. Price-fixation and control, which have been introduced and maintained in almost every other national economic activity without question, are still in a purely tentative stage with them, and it is a condition of their existence that control should be more complete, so that an adequate return on working costs should be realized.”

The purpose of this chapter has been, above all, to show the economic position of the electrical manufacturing position with special reference to manufacturing plant and machinery ; to show that, measured by ordinary economic standards, the industry is efficient and is capable of dealing with any rapid expansion that takes place in the market without difficulty ; to prove that the prices charged by it have fallen very much more rapidly than general wholesale prices, with a resultant benefit to the consumer ; and to make clear quite definitely that the industry has been saved from the worst consequences of trade depression through the combination of rationalization in manufacturing processes, amalgamation in groups between individual firms to form efficient manufacturing groups, and co-operation between all firms and all groups in a central association. In the succeeding chapters, we shall deal with the possibilities of expansion and the state of demand in the main markets available to the electrical manufacturer : (1) Overseas, (2) Home ; and we may indicate what part the electrical industry can play in the reorganization and re-equipment of the basic industries of this country.

MANUFACTURING, FINANCIAL & LABOUR CONDITIONS

In the final chapter we shall deal with certain broad movements which are taking place in industry as a whole—movements bearing on organization, on the grouping of industries within the national economic organization, on the changes that have taken place in competition viewed from a national standpoint, and on the emergence of the power industries as the most important elements making for prosperity in the future. The main impression to be gained from discussion and consideration of the statistics and theories advocated in this book is that the power industries as a whole, from being insignificant elements in industrial activity, are evolving towards a position where they themselves will constitute the background against which national economic adjustments and changes will be measured.

EXPORT TRADE: WORLD COMPETITIVE POSITION

CHAPTER III—EXPORT TRADE : WORLD COMPETITIVE POSITION

I.—THE SIGNIFICANCE OF EXPORTS

IN a country like Great Britain, dependent on a high volume of industrial production to support its population, and equally dependent on a very large export trade to maintain its international balance of payments, the significance of exports is greater than in self-contained countries like the United States or even Germany. Under ideal conditions a country should be able to supply its own requirements in food-stuffs and industrial raw materials from its own resources without incurring the necessity of importing commodities of any kind. In this case, foreign trade, either from the export or import point of view, would be non-existent or represent only a very small section of the national income. It is impossible, however, to find this ideal country, owing to the fact that raw materials are not distributed evenly over the world, and agricultural potentialities are dependent on an immense variety of conditions which are not always present. Again, the world's supplies of raw materials and, to some extent, the world's production of cereals and food-stuffs generally are limited and are not capable of indefinite expansion in any one market, while population increases indefinitely and is not directly susceptible to economic checks. Thus a time comes when the requirements of the population of a market can only be met partially from the national production and must be supplemented by imports from other countries with a surplus. The balance between production and consumption moves over to industrial products, with the result that there is always a definite surplus productive capacity in industry, which can be weighed against the falling production in agriculture.

If it were possible to effect some scientific adjustment between surplus productive capacity in certain commodities and declining capacity in other commodities and establish, through a system of exactly regulated foreign trade, a sound national budget, then the question of competitive efficiency would be less important in the discussion of trade expansion; but this adjustment cannot be made, owing to the fact that, in practically every industrial country, there is a surplus productive capacity beyond the national needs, while the principal agricultural countries find difficulty in disposing of their surplus. Other countries again, such as the United States and Canada, are self-sufficient both from the agricultural and industrial points of view, and have a surplus in both available for export, and so play an important part in

EXPORT TRADE: WORLD COMPETITIVE POSITION

intensifying international competition and in destroying any adjustment which might be made between the countries in the classes already mentioned.

It is obvious from this short sketch that an enormous waste in materials, in transport, in energy, in labour, and in wealth is incurred as a result of the inability of the main countries of the world to regulate their necessities and bring consumption into exact correlation with production. One theory that has always survived has been that exports represent a surplus and that the cost of this surplus should be such as to ensure a steady demand for it without too close consideration being paid to costs of production or net returns. This conception predominates in countries which come close to self-sufficiency, and it is well known, for example, that the export prices quoted by American manufacturers do not bear a close relation to the prices obtained by them in the home market. A similar development can be found in Germany and France, where the home production constitutes a very high percentage of the total activity and, in some industries, is sufficient to justify a loss in export trade. Great Britain, on the other hand, which is dependent for about 27 per cent of the demand for its industrial products on exports, is not in a position to carry out this theory of competitive prices based on surplus. For such a high percentage British industry must obtain from exports sufficient revenue to make them economically justifiable, and this factor is one which has impeded the expansion of British exports.

The effect of this conception is to create a distinction between prices quoted in export markets and prices quoted at home, and it will generally be found that export prices are decidedly less, but it is difficult to argue from this point of view that there should be no distinction. In the electrical industry, and in almost every industry turning out highly finished products, two factors suffice in themselves to break down this theory. They are linked up with questions of manufacturing load and manufacturing specifications. With a full manufacturing load overall costs per unit must be decidedly less than with a load amounting to only 50 or 60 or even 70 per cent of the optimum. If the manufacturer is unable to develop exports, he will find himself, in this country at least, in the position that his manufacturing load may not be more than 70 per cent of what it should be; his costs go up and the resultant price to the consumer is correspondingly higher. If he is able to bring his manufacturing load up to 100 per cent with the disposal of surplus on export account, even at a lower price (a price which is sufficient to cover costs without any surplus being created for profits), he can quote a lower price over his entire production, with the result that the home price may be less than would otherwise be the case.

The reply to this is that foreign competitors quote a lower price in the manu-

PRODUCTION PRICES FOR HOME AND EXPORT TRADE

facturer's home market, and his price should conform to this; but these foreign competitors are disposing, in their turn, of a surplus, with, however, this difference, that they are protected through tariffs from the consequence of their own action and are perfectly at liberty to reap the benefits of surplus prices in open markets like Great Britain. This, of course, is no full reply to the theory that prices should be the same for home and for export purposes; and so we come to the second factor—namely, that of manufacturing specifications.

In the electrical industry especially, the type of product required for the home market must conform to definite conditions and specifications covering design, materials, operating efficiencies, and safety margins, which are more rigid than those ruling in certain export markets. The result is that production may, in a number of products for export, be adjusted to less rigid specification and so work out cheaper, and it is, therefore, practically impossible to make a comparison between home and export prices for the simple reason that the products are not the same, even although, in the case of heavy generating plant, for example, their rated capacities may be similar. Moreover, in a very high percentage of British exports, British tenders have been accepted, largely because they adhere closely to British standards and not because they were lowest in price, while foreign firms have been able to progress in mass-production articles which do not come under these specifications. British exports in the advanced industries are invariably quality exports and command a high price, and it will be found on comparison that home and export prices, where the same products with the same specifications and the same operating conditions are in question, are almost identical.

There is a third factor which has less direct influence on the consumer—namely, that of the national balance of payments. Britain must import a great percentage of its requirements in food-stuffs and raw materials, and these imports must be met by exports developed by the manufacturing industries. It may be necessary for the national economic prosperity that such industries should develop at all costs an export surplus, if only to maintain intact the credit situation of the country and ensure provision of sufficient facilities for home production, apart from international financial exchange rates. The gradual disappearance of exports through the adoption of a policy of high prices to correspond with prices ruling at home would not only intensify depression in the home market, but it would also raise the general costs of production in every branch of national activity. It would be difficult in the light of these considerations to insist that the British manufacturer alone of all manufacturers should make no distinction between home and export prices.

The theory of the surplus and the uneconomic price has served to interfere with

EXPORT TRADE : WORLD COMPETITIVE POSITION

the normal course of trade and of demand, but to this should be added the effect of fiscal policy. High tariffs represent an artificial expedient adopted to close out foreign goods competing with home production, even where the prices of the home products are very much higher than those quoted by foreign countries. A country which, like Britain, has avoided the use of tariffs suffers above all from the inability of its manufacturers to command the entire home market and thus ensure a satisfactory volume of production, while the existence of tariffs in other industrial countries forces the British manufacturer to concentrate on markets which are only partially developed and in need of capital to ensure steady progress. This capital has hitherto been supplied by Britain. The result is that British export trade has, on the whole, been more expensive to this country than German or American export trade to Germany or America. Nevertheless, British capital investment overseas has had as a compensatory influence the effect of creating a preference for British goods where a certain degree of control obtains. Thus the British market in South America has been, and still is, dependent on investments made by British capital in railways and public utilities, where a British directorate and British control accompanied such investment. We shall deal later with this question of financial penetration, since it has assumed very considerable importance since the conclusion of the war, but it is sufficient to note here that, during the post-war decade, this compensatory factor has not been in play to the same extent as before the war, for other countries have adopted with success the principle of financial penetration combined with control.

British exports have also been stimulated through British technical and scientific enterprise, through the creation of a tradition for high quality and economic operation, and through rapid and effective transport accompanied by a very high margin of safety in deliveries, and through the provision of an insurance and financial transfer service superior to anything yet evolved in any other country. With these factors in operation, the export trade of Britain expanded continuously up to the beginning of the war, and Britain was responsible for a very high percentage of the total of world trade. Since the war the position has changed, and export trade has not expanded at the same rate as previously, while imports have grown out of all relation to what might be considered an economic balance. The home consumption is being met now by an excessively high percentage of imports, above all by products which can be manufactured in this country. These imports have been encouraged, first of all, by international competitive conditions resulting from currency depreciation in Europe and the policy of inflation adopted by practically every European country, by the inability of the British manufacturer to quote down

ADVERSE FACTORS AFFECTING POST-WAR EXPORTS

to the Continental level and still sustain the burden of taxation imposed on him by war expenditure, and by the unsatisfactory condition of the home market itself, where the distributing and intermediary trades have been able to organize themselves into large-sized combines capable of financing very heavy imports, with no concern other than that of obtaining the maximum profit possible on the turnover they handle. A characteristic of the post-war decade has been exactly the strengthening of what might be regarded as the intermediate consumer and the weakening of the producer both in administration and in the disposal of financial resources.

In exports, severe impediments have also been felt: first of all, as a result of the decline in the savings available for investment abroad, largely due to taxation; secondly, through the diminution of earning capacity of industrial firms themselves, rendering it impossible for them to realize surpluses for the financing of export trade out of their own resources; and, thirdly, through the expansion of foreign investment as the result of bond and debenture issues and short-term credits, which do not bear with them control. In this last case, no discrimination has been made in the destination of foreign loans, and British export trade has hardly benefited at all from the overseas lending that has taken place since the conclusion of the war. This lending has rather served to increase the resources of competitors abroad and to expand their home market through the provision of capital to consumers. The London money market has ceased to have any connection with the evolution of British export trade.

At this time one must note the entrance of the United States into international finance and the gradual displacement of Britain as the principal source of capital investment in the world. Thus the total of American foreign investments has risen from \$8,522,000,000 in 1922 to \$12,187,000,000 at the end of 1927, while investments of foreigners in American securities and properties have only increased from \$2,808,000,000 in 1922 to \$3,700,000,000 in 1927. The balance of investments, therefore, has been increasingly on the side of America and has been active in stimulating American exports, while foreign countries, and, above all, Great Britain, have not been able to secure similar advantages in America, where pre-war investment has practically disappeared. An analysis of American investment abroad, including all forms of discounts and credits and investments, shows that America placed abroad in 1922 \$1,294,000,000 and in 1927 \$2,674,000,000, the increase, with the exception of 1923, being practically in a straight line. American investment, especially in 1928 and 1929, has ceased to take the form of bonds and debentures and long-term credits. It has now moved over to investment in ordinary shares and in stock bringing with it control, and the result is that America will be

EXPORT TRADE : WORLD COMPETITIVE POSITION

able to use this financial instrument more effectively in the future than in the past. British investment, on the other hand, has moved over predominantly to bonds, debentures and long-term credits, where no control is possible, and investment in ordinary shares and in ordinary stock is no longer taking the form of development of new enterprises in important markets, but the allocation of surplus funds available for investment on the part of institutions, like investment trusts, in undertakings abroad which are already well established and are not subject to influence from the British investment.

These general factors are of importance even in consideration of British electrical export trade. Electrical exports are perhaps the most effective indication of the economic development of any market. Industrialization means the equipment of factories and of manufacturing plants, and a very high percentage of this equipment is met by electrical and allied manufacturers. Again, public utilities, owing to the rapid forward advance in electricity as the main source of energy, have come to connote more and more electrical development on a large scale, and such utilities bear a close resemblance to railways not merely through the part they play in the State economy, but also through the nature of their administration and the description of capital investment. British electrical exports are peculiarly sensitive to economic changes in markets, and they are affected at once by developments in fiscal policy and finance and even in politics which have a bearing on the state of industry. One would expect, therefore, to find a close correlation between British exports and the state of trade in markets where industrial development has either been delayed or only been undertaken on a wide scale within recent years. There is the consideration that electricity represents a growing demand in every country in the world, its potentialities are apparently inexhaustible, and there is no evidence of saturation point being reached even in highly exploited countries like America.

The result of this has been that the world export trade has moved upwards fairly steadily since the beginning of this century, and even a period of international disturbance as severe as that of the Great War has not been able to check seriously this upward movement. Thus, between 1913 and 1928, the total world exports of electrical goods and apparatus rose from about £37,500,000 to rather more than £75,000,000, an increase of exactly 100 per cent. The increase recorded would have been greater still but for the direct encouragement of home production by a number of countries which were once dependent on imports for their requirements. Chief among them should be mentioned France, Italy, Belgium, Holland, Canada, and Japan. With an expanding demand, one would expect an improvement in the exports from the principal industrial countries, provided, of course, that a fairly

AN UPWARD MOVEMENT OF THE EXPORT TRADE

even distribution were to take place in the markets supplied by such countries. Thus a country exporting predominantly to markets such as those mentioned, where home production was assuming an increasingly important rôle, would not show the same rate of increase as countries which have no manufacturing industry at all. As we shall show later, none of the principal export countries are in this position, so that one might expect a fairly even international advance, provided that the British manufacturers can overcome the disabilities under which they suffer as a result of economic conditions ruling in Great Britain.

II.—THE EXPANSION OF BRITISH ELECTRICAL EXPORTS

The expansion of British electrical exports since 1903, the first year for which reliable statistics are available, up to 1929 is shown in Table XXVI. (page 74). A distinction has been made, on the one hand, between electrical machinery, which includes dynamos, generators, traction motors, rotary converters, control and switchgear, transformers, and motor-driven devices, and, on the other, electrical apparatus, which covers every other product in the electrical category. From 1903 to 1908 the expansion of exports was not particularly great, taking electrical machinery and apparatus as a whole. The industry was struggling for its existence and had not yet reached the stage where it was even accepted as potentially important. It is quite possible that progress in home consumption may have rendered export business unnecessary, but we have no exact knowledge to guide us in this matter, and the assumption is rather that the initial development of the industry had not yet reached a stage where a real foundation could be established. From 1909 to 1913, with the exception of the year of crisis 1911, expansion was very rapid and showed that the work of the previous six years had already been successful to some extent in creating a goodwill for the industry. In addition to this there was a slight rise in the prices of electrical products, due to an improvement in world trade generally. The war years have no significance, since production was seriously disturbed and a large percentage of productive capacity was engaged on munitions. The two years, 1920–21, were boom years, characterized by very high prices, followed by a collapse in 1922. From 1923 onwards, even during a regime of falling prices, the value of exports has moved steadily upwards, although one might assume that a temporary check has intervened in this upward movement. Such a check is due to a recession in trade in some of the Dominions and to the increasing competitive force exerted by Germany and the United States.

An examination of the machinery figures alone gives a slightly different picture.

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XXVI—EXPORTS * OF ELECTRICAL MACHINERY AND APPARATUS
FROM GREAT BRITAIN

(1903-1928)

Year.	Electrical Machinery.		Electrical Apparatus.	Electrical Machinery and Apparatus (Value).
	Tons.	Value.		
1903	—	£472,000	£2,522,000	£2,994,000
1904	8,700	607,000	1,656,000	2,263,000
1905	9,600	684,000	2,104,000	2,788,000
1906	12,400	884,000	2,493,000	3,377,000
1907	13,300	1,039,000	2,628,000	3,667,000
1908	18,800	1,386,000	2,086,000	3,473,000
1909	19,000	1,472,000	2,359,000	3,831,000
1910	22,100	1,652,000	4,307,000	5,959,000
1911	23,200	1,851,000	3,015,000	4,866,000
1912	24,600	2,038,000	4,567,000	6,605,000
1913	27,700	2,380,000	5,714,000	8,094,000
1914	25,300	2,215,000	3,404,000	5,419,000
1915	16,800	1,426,000	3,328,000	4,754,000
1916	18,600	1,595,000	4,231,000	5,826,000
1917	15,300	1,520,000	4,112,000	4,632,000
1918	10,400	1,030,000	2,452,000	3,482,000
1919	11,800	1,670,000	5,970,000	7,640,000
1920	11,973	2,711,000	11,760,000	14,471,000
1921	18,288	4,777,000	13,257,000	18,034,000
1922	17,012	4,207,000	7,458,000	11,665,000
1923	21,293	4,061,000	10,330,000	14,391,000
1924	31,618	5,440,000	10,842,000	16,282,000
1925	33,424	5,829,000	11,812,000	17,641,000
1926	34,621	5,899,000	13,546,000	19,445,000
1927	41,168	6,827,000	12,030,000	18,857,000
1928	41,728	6,848,000	11,796,000	18,644,000

* Including re-exports.

In machinery, the entire pre-war period from 1903 onwards was one rapid and continuous expansion. Exports in tonnage in 1913 were almost three times those of 1905 and four times those of 1903, while in value the improvement was greater still, shipments in 1913 being almost exactly five times those of 1903. Such a movement in machinery served to conceal marked competitive weakness in apparatus, the 1903 figures for apparatus being only exceeded in 1910, while a definite expansion was recorded in 1912. In machinery again, the war years have no significance, but they do show how greatly the industry suffered from the enforced abstention from trade in overseas markets, the tonnage of exports in 1918 being not

ANALYSIS OF EXPORTS—MACHINERY VERSUS APPARATUS

much more than one-third of those in 1913. 1920–21 and 1922 were years of recovery, 1921 being a boom year, but it was only in 1924 that the pre-war tonnages were exceeded. From that year onwards, there has been a steady upward movement, with the result that in 1928 export shipments of machinery were 52 per cent above those of 1913. It is interesting to note that the year of crisis, 1922, had less effect on machinery exports than on apparatus, but recovery was less rapid in 1923, and this would indicate that machinery contracts may take from a year to eighteen months to complete, while apparatus has shorter delivery dates.

Contrasted with machinery, apparatus has repeated the pre-war story. It has shown practically no increase in value since 1920 at a time when machinery had actually improved to the extent of 50 per cent, even allowing for the effect of falling prices. The competitive strength of the industry does not lie in apparatus but in machinery, and if the former had progressed as rapidly as the latter, the total of electrical exports would now have been not £19,000,000 but rather more than £23,000,000. It is to apparatus that one must attribute the slight fall that has taken place in the world position of Great Britain since 1927. One would expect such a development, however, owing to the fact that mass-production and low rates of wages play a much greater part in demand for apparatus than quality or efficiency or economic design. Competition can be met more effectively in machinery than in apparatus, purely through the operation of factors which distinguish British production above all other.

In Table XXVII. a survey in close detail is given of movements in exports since 1920. It is impossible to establish the pre-war position, owing to the fact that the classification was altered in 1920, and it is doubtful whether, in view of the rapid technical changes that have taken place in manufacture and in design, pre-war detailed figures would be of more than purely historical value. From this table re-exports have been excluded, but allied machinery, such as steam turbines and steam condensers, have been added to give a picture of the real exports of the electrical export trade. Steam turbines, after reaching a remarkably high level in 1921, were practically stationary at a much lower level in 1924–26, declined heavily in 1927, and showed a rapid recovery in 1928 and 1929. Steam condensers reached a record export figure in 1928. The greatest improvement has been recorded by generators, especially A.C., the 1928 figures being almost twice those of 1921, while D.C. generators, after reaching a high total in 1924, have only improved slowly. The position here must be attributed to a change in power production practice and, secondly, to a reduction in the market open for D.C. generators. The influence of very large railway electrification schemes carried out in the post-war

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XXVII—ELECTRICAL EXPORTS OF GREAT BRITAIN
(1920-1928)

Classification.	1920.	1921.	1924.	1925.	1926.	1927.	1928.
Steam turbines	£278,017	£1,106,007	£549,725	£614,316	£598,729	£530,786	£770,324
Steam condensers	79,880	231,212	—	—	—	154,602	285,140
A.C. generators	106,850	459,044	707,825	404,661	557,392	672,904	846,909
D.C. generators	261,785	473,878	544,593	391,546	389,479	423,115	430,698
Rail and tram motors	49,265	194,516	577,819	545,632	487,491	495,159	475,191
A.C. motors	412,197	1,051,306	568,916	807,009	762,415	788,549	779,133
D.C. motors	554,711	668,709	499,807	551,963	520,285	472,003	376,157
Rotary converters	180,421	404,759	268,129	339,773	336,583	411,502	301,886
Static transformers	160,974	421,139	430,892	539,948	539,957	597,371	583,936
Control and switchgear	187,671	550,172	945,251	1,359,579	1,334,837	1,604,445	1,709,515
Switchboards other than telegraph and telephone	117,209	239,450	88,155	84,782	74,524	74,516	72,857
All other electrical machinery	—	—	781,513	792,674	919,090	1,245,769	1,112,906
Commercial instruments	—	—	—	—	—	184,100	180,115
House service meters, complete	376,795	450,545	170,327	115,734	152,051	125,165	139,842
House service meters, parts	—	—	27,381	18,806	16,646	6,311	7,126
Scientific instruments	20,385	40,423	67,635	66,969	64,723	68,605	51,268
Electric lamps :	—	—	—	—	—	—	—
Gas-filled	37,318	136,205	137,545	230,082	205,833	264,859	258,248
Other	282,536	306,976	203,701	280,749	295,130	328,415	274,334
Arc lamps and searchlights	—	—	7,065	11,720	5,179	15,301	13,396
Arc lamps and searchlights, parts	—	—	3,482	4,592	4,455	6,379	7,645
Batteries, primary :	—	—	—	—	—	—	—
Hand flash lamps	206,821	175,602	12,294	11,427	15,271	14,234	12,362
Other	—	—	112,455	137,835	127,920	164,234	133,932
Accumulators :	—	—	—	—	—	—	—
Portable	421,453	500,047	210,082	338,892	396,486	517,814	481,018
Stationary	—	—	407,393	485,098	479,810	537,386	454,087
Telegraph and telephone instruments :	—	—	—	—	—	—	—
Wireless (except valve)	258,060	155,273	465,292	1,106,445	1,101,630	1,005,233	950,236
Other	316,373	561,127	393,862	1,724,886	2,025,138	1,677,166	1,673,823
Wireless valves	—	—	—	183,304	170,032	213,381	179,870
Electric wires and cables, insulated :	—	—	—	—	—	—	—
Rubber insulated	1,753,449	1,231,812	1,322,836	1,428,411	1,580,904	1,448,459	1,403,186
Insulation other than rubber	2,040,575	2,074,784	1,183,631	1,237,034	1,765,689	1,581,698	1,464,828
Telegraph and telephone wires and cables	1,039,765	1,618,953	1,021,999	705,357	823,290	954,772	855,418
Submarine telegraph and telephone cables	1,776,940	2,146,264	948,156	1,601,401	2,001,016	550,973	630,301
Electric lighting accessories and fittings (including switches)	812,092	796,213	603,496	654,234	666,304	650,932	640,560
Ignition magnetos	45,231	31,054	28,340	29,540	39,932	56,396	1
Permanent magnets	—	—	1,206	4,127	8,357	11,275	40,826
Electro-medical apparatus	—	—	17,951	15,994	18,985	27,117	29,568
X-ray tubes and vacuum tubes	63,244	78,289	176,403	10,496	11,101	11,731	15,722
Vacuum cleaners	—	—	†	†	†	42,847	32,335
Electric carbons :	—	—	—	—	—	—	—
Lighting	—	—	†	†	†	†	†
Furnace	148,889	69,795	†	†	†	†	13,726
Other	—	—	†	†	†	†	†
Electric bell apparatus	19,999	7,736	†	†	†	†	7,581
Electric porcelain	209,795	232,708	194,511	195,758	188,503	181,502	187,612
Electric glass ware	—	—	58,620	57,309	58,197	69,576	71,480
TOTAL (including apparatus N.E.S.)	£14,840,171	£19,349,019	£16,836,894	£18,236,313	£20,028,393	£19,528,247	£19,599,092

* Included in X-ray tubes. † Not separately stated. ‡ Excluding condensers, but including items not enumerated above.

decade can be seen in the railway and tramway motor exports, where 1921 statistics were only one-third of those recorded in 1924. Since 1924, however, there has been a slow but steady decline in shipments, due to the fulfilment of large contracts secured during 1922, 1923, and 1924.

In A.C. and D.C. motors, the position is unsatisfactory, if 1921 is taken as a basis. A.C. motor exports in 1928 were only 76 per cent of those ruling in 1921, while D.C. motors were only 60 per cent, although it should be noted that a fairly

EXPORT ANALYSIS, MOTORS, CONTROL GEAR, APPARATUS

rapid upward movement took place in A.C. motors from 1924-25, with a very small decline to a stable level in 1926. Rotary converters are also unsatisfactory and have probably been affected by the completion of railway electrification contracts. The two items, control and switchgear and transformers, together show the most spectacular movement, the 1928 figures being exactly two-and-a-half times those of 1921. This development illustrates the tendency already noted—namely, the development of the transmission and distribution side of electricity supply in advance of power plant requirements. Such a change is tantamount to a shifting of the balance of production in electrical engineering. Switchboards have fallen rapidly without interruption since 1921, and, in view of the remarkable increase that has taken place in control and switchgear, it is difficult to explain why such a decline should have occurred. Meters and instruments, as one would expect, in view of the ease with which production lends itself to manufacture in series, to the use of standardized parts and simplified methods of assembly, and to the employment of semi-skilled cheap labour in foreign countries, have not reached in any year of the post-war decade the level of 1921.

Among the products entering into the apparatus category, easily the greatest expansion has taken place in telephonic and telegraphic instruments and, above all, in wireless. There has been a fall in the exports of electric wire and cables for power purposes, the exceptional year being 1926. Submarine telephonic and telegraphic cables, influenced adversely by the rapid expansion of wireless communications, have shown perhaps the greatest decline, exports in 1928 being barely one-fourth of those in 1921. This market is purely speculative, owing to the fact that it is dominated by very large contracts with wide intervals between them. Batteries and accumulators also show a very rapid improvement, with, however, a fall in 1928 from the record figures established in 1927.

The total exports of all electrical and allied products reached the highest point in 1926, at about £20,350,000, including condensers. This figure was almost exactly about £1,000,000 above the 1921 previous record. In 1927-28 a considerable fall took place, but the returns for 1929 show that a new record will probably be established.

The picture presented by this table is certainly not one of uniform advance in every section of the industry. As a competitive diagram, it is extremely patchy, but it does show that, on the heavy generating plant side and in railway electrification material as well as heavy transmission and distribution equipment, the industry has made very rapid progress indeed, even during a period of falling prices, and this progress must be due not merely to marketing enterprise but also to the increasingly

EXPORT TRADE : WORLD COMPETITIVE POSITION

important part played by achievement as represented by operating performances in creating a powerful export goodwill.

We have deliberately made a comparison with 1921 to show how great this advance has been, but it should be noted that the 1921 figures were unduly inflated through the incidence of an abnormal demand from one market—namely, India. British exports to India in 1921 reached the remarkable figure of more than £5,000,000, compared with £2,600,000 in 1927. There has thus been a fall of almost £2,500,000 in one market alone, so that, if we exclude it, the increase would have been from £14,000,000 exported in 1921 to £17,000,000 in 1927, an improvement of 20 per cent. If it were possible to give a volume or horse-power figure, it would probably be twice that of 1921.

It has already been shown that the competitive strength of the industry has not been evenly distributed over all products, the balance tending in favour of electrical machinery. A similar observation applies to the territorial distribution of these exports. One would expect very considerable differences in shipments to various countries, owing to economic conditions and owing to the influence exerted by factors outside of those of supply and demand—political, financial, and even technical. Thus, in countries where technical practice is predominantly British and the consulting engineers have been educated in British universities and workshops, there would be a marked preference for the British product, if only because the engineers have been familiar with it. A similar observation applies to countries where foreign practice predominates.

Again, the control of supply undertakings and of large industrial companies abroad may be predominantly British through the fact of capital investment, or British influence may be fairly strong through representation on the board of directors or through the nomination of consulting engineers to the undertaking, and this again can be a factor in deciding territorial distribution. In the third place, political considerations are of importance, inasmuch as certain large markets, such as the Dominions and Colonies, are either within the British sphere of influence or administration, and in these markets it becomes a matter of steady policy for Britain to encourage imports from them in return for a preference shown for British goods. These three factors have been most active in causing the expansion in the special territorial distribution of British electrical exports, and the result has been that the leading markets come under all or any one of these categories.

The Dominions have been responsible for the greatest percentage of British export trade, the present figure being in the vicinity of 65 per cent. To obtain some historical perspective, we have made a selection of sixteen representative markets in

THE BRITISH EXPORT TRADE TO THE DOMINIONS

Tables XXVIII. and XXIX. Table XXVIII. covers the years 1903-19, when classifications remained much the same. A break occurred in 1920, with an extension of the export trade classifications and the introduction of new products into the machinery category, and Table XXIX. shows developments since 1920 to 1928, with a distinction made between machinery and apparatus.

TABLE XXVIII—EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS
FROM GREAT BRITAIN TO PRINCIPAL MARKETS

1903-1919

(Sterling; 000's omitted)

Market.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Australia . . .	282	256	228	231	309	421	536	705	995	1414	1297	1031	975	1084	426	253	878
India	304	204	296	299	366	398	381	386	423	481	612	685	521	699	474	463	1103
South Africa . . .	375	398	375	263	527	155	309	556	480	424	481	419	279	679	403	296	900
New Zealand . . .	72	77	75	80	98	114	133	112	152	241	230	213	253	261	104	68	194
Canada	20.	56	51	55	67	62	129	198	204	431	372	307	111	214	68	62	78
Argentina	99	77	131	291	224	311	329	370	379	390	599	480	282	194	126	71	251
Brazil	51	87	82	135	152	136	211	390	296	238	361	175	72	24	42	35	195
Chile	12	16	199	30	57	35	58	64	105	132	30	38	72	25	21	71	
China	20	34	27	63	107	127	103	104	85	86	144	112	73	149	71	55	339
Japan	87	157	406	260	270	311	425	542	435	435	297	315	127	179	59	31	171
France	18	21	22	12	26	42	35	66	107	136	181	153	320	585	962	1007	554
Italy	4	3	6	24	39	2	71	42	62	126	86	58	109	112	175	105	221
Spain	8	7	19	17	13	—	23	36	71	122	124	77	50	106	83	59	201
Norway	—	—	—	—	—	—	5	6	8	21	27	15	149	135	313	157	394
Denmark	4	2	3	—	—	—	36	13	30	35	77	36	9	10	2	—	49
Russia	25	32	49	75	63	80	49	43	85	95	105	158	250	243	660	—	44

The figures for the year 1903 cover perhaps what might be regarded as the first year of large-scale British electrical exports. We have omitted from consideration allied machinery such as steam turbines, steam condensers and pumps, owing to the fact that it has been impossible to segregate these items over the period in question. One can assume, however, that exports in these products would follow the trend of electrical machinery exports. Examination of the table induces certain interesting conclusions regarding the state of industrial development of the Dominions. Thus, in 1903, South Africa was the main market, but exports to it showed practically no improvement during the entire period 1903-18, 1907, 1910, and 1916 alone being years of heavy shipments. This would indicate either that South Africa industrially has developed very slowly, or that the British competitive position was growing steadily weaker from 1903 onwards. A combination of both these factors provides probably the best explanation. India came second in importance in 1903 and remained practically stationary for four years. From 1907 onwards began what may be regarded as the first stage in Indian industrial expansion, resulting from the establishment of the Indian jute manufacturing and cotton-spinning industry. This expansion continued without interruption until 1914 and was resumed in great volume from 1919 onwards.

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XXIX—EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS
FROM GREAT BRITAIN TO PRINCIPAL MARKETS

(1920-1928)

(Sterling; 000's omitted)

Market.		1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Australia	Machinery . . .	397	786	822	760	914	1010	988	1255	954
	Apparatus . . .	1128	2079	1202	1999	2564	2348	3608	3169	2310
	Total . . .	1525	2865	2114	2759	3468	3358	4596	4424	3264
India	Machinery . . .	741	1563	1465	888	955	1061	1307	1153	1429
	Apparatus . . .	2478	3518	1612	1263	1075	1155	1220	1446	1389
	Total . . .	3219	5081	3077	2151	2030	2216	2527	2599	2818
S. Africa	Machinery . . .	191	259	173	274	924	712	704	1042	459
	Apparatus . . .	776	835	422	663	875	773	854	841	691
	Total . . .	967	1094	595	937	1799	1485	1558	1883	1150
New Zealand	Machinery . . .	42	113	203	235	359	359	284	427	352
	Apparatus . . .	433	522	324	666	816	805	914	795	670
	Total . . .	475	625	527	901	1175	1164	1198	1222	1022
Canada	Machinery . . .	30	27	45	77	230	181	232	238	254
	Apparatus . . .	280	168	187	191	195	207	193	219	224
	Total . . .	310	195	232	268	425	388	425	457	478
Argentina	Machinery . . .	67	329	149	95	107	172	194	220	540
	Apparatus . . .	485	727	340	534	578	590	1039	655	913
	Total . . .	552	1056	489	629	685	762	1233	875	1453
Brazil	Machinery . . .	58	70	79	98	121	171	91	180	129
	Apparatus . . .	254	185	128	125	153	132	200	155	176
	Total . . .	312	255	207	223	276	303	291	335	305
Chile	Machinery . . .	22	55	68	51	70	40	81	89	42
	Apparatus . . .	88	266	288	101	116	103	221	106	205
	Total . . .	110	321	356	152	186	143	302	195	247
China	Machinery . . .	112	288	213	129	87	103	60	103	99
	Apparatus . . .	408	514	324	143	132	137	190	133	218
	Total . . .	520	802	537	272	219	240	250	236	317
Japan	Machinery . . .	26	54	64	121	256	222	180	322	185
	Apparatus . . .	426	229	518	336	632	758	415	408	151
	Total . . .	452	283	582	457	888	980	595	730	336
France	Machinery . . .	183	146	132	183	129	113	85	137	87
	Apparatus . . .	202	166	129	135	216	268	206	232	250
	Total . . .	385	312	261	318	345	381	291	369	337
Italy	Machinery . . .	62	20	19	15	12	7	17	35	33
	Apparatus . . .	89	40	14	74	63	933	53	116	358
	Total . . .	151	60	33	89	75	940	70	151	391
Spain	Machinery . . .	96	140	67	187	84	110	62	154	134
	Apparatus . . .	134	153	85	135	149	204	257	221	157
	Total . . .	230	293	152	322	233	314	329	375	291
Norway	Machinery . . .	12	4	12	2	2	6	5	20	25
	Apparatus . . .	698	156	60	87	40	52	29	32	28
	Total . . .	710	160	72	89	42	58	34	52	53
Denmark	Machinery . . .	9	2	1	3	3	—	—	4	22
	Apparatus . . .	257	46	91	79	67	103	146	137	155
	Total . . .	266	48	92	82	70	103	146	141	177
Russia	Machinery . . .	1	1	1	16	102	326	280	83	239
	Apparatus . . .	57	6	41	3	48	91	45	69	28
	Total . . .	58	7	42	19	150	417	325	152	267

Australia showed the most rapid and, in some ways, the most spectacular advance of all three. It began to progress definitely from 1907 onwards, and the rate of acceleration became steeper every year, with the result that exports in 1912

DESCRIPTION OF PRE-WAR BRITISH EXPORT MARKETS

were five times those of 1903. During the war years the Australian market was supplied by America, but from 1920 onwards American domination began to fall away, and Britain shared again in the remarkable post-war developments that have taken place in that country. A less marked upward movement took place in New Zealand, with the exception that from 1903 to 1913 it moved up without interruption and continued until 1916. The war affected it from 1917 to 1919. Canada has always been an American preserve, and the British figures are, therefore, no indication of the state of industrialization in that country. It is worth noting, however, that even here British exports improved very rapidly from 1903 to 1912 and were threatening, before the war broke out, to draw even with American shipments; but the war restored American predominance.

The effect of British capital investment in South America can be seen in Argentina and Brazil. The expansion that took place in Argentina between 1903 and 1913 was more rapid, as far as British electrical exports were concerned, than even that which took place in Australia. The result was that, before the war, Argentina was the third most important market, being only slightly less than India. Brazil showed a very similar upward movement in a much smaller volume, and it was followed by Chile lower still in the scale, so that for these three South American Republics the progress in British exports over ten years was relatively greater than for any three other markets in the world. Japan and China moved upwards also with considerable rapidity, the Japanese position being affected undoubtedly by political agreements with Great Britain and by the determined attempt of the Japanese Government to introduce Western industrial methods under British advice. The result was that electrical exports were in 1910 more than six times those of 1903, and Britain dominated the market; but from 1910 onwards America secured a much greater percentage and there was a loss of competitive power on the part of British manufacturers. The war intensified that loss, and the result has been that this market is only now being reconquered.

In Europe the only markets of importance were Russia, France, Spain, and Italy, and in combination they were less important than the Argentine alone. The effect of the war can be seen in the remarkable increase that took place in shipments to France in 1915-19 and to Russia from 1914 to 1917, when the revolution interrupted communications with this country. On the whole, therefore, British electrical export trade before the war was most active in Argentina, Australia, India, Japan, Brazil, South Africa, and New Zealand. It had made practically no impression on Europe.

The post-war years have reproduced almost without change the position ruling

EXPORT TRADE : WORLD COMPETITIVE POSITION

before the war. Australia is now easily the most important market Britain possesses, and its rate of expansion since 1920 has been almost spectacular. British exports in 1927 were actually more than three times those of the pre-war record year and one-and-a-half times those of 1921, a time of very high prices. The advance has been evenly distributed between machinery and apparatus. These statistics illustrate the very great effort made by the Dominion to extend the utilization of its natural resources ; to carry out large power schemes, both steam and hydro-electric ; to lay down manufacturing plant, especially in the metal-working industries, and to improve its transport system through the electrification of suburban lines. Australia has probably advanced more rapidly electrically and even industrially than any other country in the world, not excluding the United States, but, as the 1927 and 1928 figures show, the first years of expansion are coming to an end, and there may be a period of comparative quiescence. It is true, of course, that trade conditions in Australia during 1927 and 1928 have not been altogether satisfactory, while the economic position of the Dominion has been under review. It may be possible that capital expenditure on development has expanded much more rapidly than the increased earning capacity arising from such development would allow, and some time may elapse, therefore, before adjustment takes place.

India had a remarkable boom period covering the three years 1920-22, and this period coincided with the electrification of a large number of factories in the textile industry and the installation of very large power plants in the new iron and steel and metal-working industries. From 1922 to 1924 a decline set in, largely as a result of the collapse of the Indian currency and of a definite recession in trade, accompanied by constriction of the purchasing power of the Indian population ; but since 1925 there has been an improvement, which may be expected to accelerate during the next few years. Very large water-power and railway electrification schemes are now under construction, and a second phase in Indian industrial activity has begun. This market may, therefore, in a few years, exceed Australia in importance. Statistics show that power plant and machinery generally have always played a predominant part in the market, apparatus being relatively less important.

A similar observation can be made with reference to South Africa, where the principal demand for electrical products comes from the mines and from public supply undertakings and from the railways serving the mines. Machinery, therefore, has occupied a much larger percentage of the total exports than apparatus and will probably continue to do so. The four years of greatest expansion have been 1924-27, largely as a result of extensions of generating stations, of main-line electrification in the area of the mines, of suburban electrification at Cape Town, and of the installa-

DESCRIPTION OF POST-WAR BRITISH EXPORT MARKETS

tion of very large winding and air-compressor equipment in the mines themselves. 1928 was characterized by a decline in this activity, but there are indications that 1929 should show a continuation of the advance. The figures are important as indicating the first great movement towards intensive economic and industrial development, which may bring this Dominion into line with Australia and India. New Zealand has continued its upward advance from the pre-war days, the only year of decline being 1922, so that this market has presented the unusual spectacle of an advance over 26 years with practically no interruption, if the three years 1917-19 are omitted from consideration. The growth of this market must be attributed to the exploitation of water-power resources and the national enterprise in developing electricity consumption. The four Dominions mentioned have been characterized, therefore, by what must be regarded as remarkable economic expansion and with this a remarkable increase in productive capacity.

Canada has less interest for the British manufacturer owing to the fact that American interests are strong there, so that the British export figures afford no indication of economic movements in that territory. It is evident, however, that an attempt is being made to reconquer this market as far as electrical machinery is concerned, but the position in apparatus is entirely unsatisfactory.

Argentina has resumed its pre-war position as one of the most important markets open to the British manufacturer, and the improvement recorded since 1920 has been almost on a level with that already discussed in connection with the Dominions. This market is characterized by the predominance of very large contracts, with the result that the figures fluctuate violently from year to year; but it is interesting to note that shipments in 1928 constitute a record to this market, electrical machinery being especially important. Brazil, on the other hand, possibly owing to difficult trade conditions, has not been a satisfactory market, no real improvement having been recorded during the post-war years, although the machinery position is relatively better. Chile has fluctuated violently around £250,000 and is not at the moment a promising market, owing to the predominance of German and American interests. It is obvious, therefore, that a special effort is required before either Brazil or Chile will yield their full quota of contracts to British industry.

Difficult economic and political conditions made trade with China less secure and less hopeful than before the war, but this market has shown a very considerable advance now over the pre-war figures, if we consider the years 1923-27 as years of crisis, during which the situation in the country would not permit of normal trading relations. China has shown much the same tendency as India, for the same reason—namely, intensive industrialization during the boom period when credit was

EXPORT TRADE : WORLD COMPETITIVE POSITION

plentiful, followed by a time of quiescence and even depression, with the possibilities of very rapid improvement in 1928 and onwards. One would expect the shipments to that territory to resume the expansion which was interrupted in 1922. Japan, which, as we have seen, was an important source of demand before the war but during the war was in danger of being monopolized by the United States, moved over more decidedly in favour of Britain from 1923 to 1925, so that there is some prospect of this market being once more an important outlet for British products. Since 1925, however, the competitive position has become much more complicated, and it has been accompanied by severe trade depression, with the result that shipments in 1928 were much less than even before the war ; it is actually necessary to go back to 1908 to find figures as low. It is probable, however, that some improvement will take place in the future.

Europe as a whole has remained virtually stationary since 1920, with, however, some indication of a slight improvement in 1928, the countries responsible for such an improvement being Italy, Denmark, Russia, and a number of what might be regarded as entirely new markets. In Italy, Norway, and Denmark, power plant equipment has ceased to be supplied from Britain, and shipments have taken a special character, represented largely by telephonic and telegraphic apparatus, submarine and other cables. The most important development in Europe, which will be discussed later when a comparison is made between the main competing countries in export trade, has been the capacity of the British manufacturer to develop subsidiary sources of demand and to open up new territories quite outside those in which Britain before the war was active. This has been a factor compensating for the serious decline which took place, for example, in shipments to British Colonies and Dominions during 1928. It is all the more notable when the effect of Reparations in stimulating German exports to European countries is understood.

III.—INTERNATIONAL ELECTRICAL EXPORT TRADE

A mere examination of the British position without reference to world competition would only serve to throw out of perspective all question of the future and present achievement of the British electrical industry in export markets. It is against the background of such international competition that the British effort must be measured, and it is necessary to embark on a fairly extensive international survey. This has been done in a series of tables from XXX. XXXVIII.

There is a difference between the figures for 1927 and 1928 as given in Tables XXX. and XXXI. ; in Table XXX. a number of items have been eliminated

INTERNATIONAL ELECTRICAL EXPORT TRADE

from the French, German, and American figures, which do not compare directly with the British and could not be regarded as purely electrical. The German figures have been reduced also by the amount of Reparation deliveries in kind attributed to the electrical contracts, so that a comparison with 1913 could be established with a fair degree of accuracy. In Table XXXI., which is a summary table of the series,

TABLE XXX—EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS
FROM FIVE COUNTRIES
(1913, 1924-1928)

Country Exporting.	1913.	Per cent of Total.	1924.	Per cent of Total.	1925.	Per cent of Total.
Great Britain. . .	£7,655,700	23·4	£16,229,000	30·4	£17,564,000	31·4
United States . . .	5,790,000	17·7	16,500,000	30·9	16,300,000	29·2
Germany	15,887,700	48·5	14,246,000	26·7	15,900,000	28·5
France	2,185,000	6·7	4,400,000	8·2	4,000,000	7·2
Switzerland . . .	1,240,000	3·7	2,100,000	3·8	2,120,000	3·7
Total	£32,758,400	100·0	£53,475,000	100·0	£55,884,000	100·0

Country Exporting.	1926.	Per cent of Total.	1927.	Per cent of Total.	1928.	Per cent of Total.
Great Britain. . .	£18,194,000	30·8	£18,769,000	31·4	£18,334,000	27·4
United States . . .	17,600,000	29·7	17,420,000	29·1	20,630,000	30·8
Germany	17,300,000	29·3	18,212,000	30·4	22,000,000	32·6
France	3,880,000	6·5	2,931,000	4·9	3,320,000	4·9
Switzerland . . .	2,180,000	3·7	2,498,000	4·2	3,063,000	4·3
Total	£59,154,000	100·0	£59,829,000	100·0	£67,347,000	100·0

TABLE XXXI—ELECTRICAL EXPORTS FROM SIX COUNTRIES
(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . . .	£11,983,481	£11,556,282	£6,785,343	£6,777,341	£18,768,824	£18,333,623
U.S.A.	13,700,000	15,950,000	5,210,000	4,680,000	18,910,000	20,630,000
Germany *	11,780,000	13,860,000	7,730,000	9,960,000	19,510,000	23,820,000
France	1,903,000	1,892,000	1,028,000	1,428,000	2,931,000	3,320,000
Switzerland . . .	1,368,810	1,620,730	1,128,760	1,442,670	2,497,570	3,063,400
Belgium	1,444,000	1,650,000	225,400	237,500	1,669,400	1,887,500
Total	£42,179,291	£46,529,012	£22,107,503	£24,525,511	£64,286,794	£71,054,523

* Including Reparations payments.

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XXXII—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO BRITISH DOMINIONS AND COLONIES *

(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . . .	£8,022,772	£6,820,206	£4,618,901	£4,453,143	£12,641,673	£11,273,349
U.S.A.	5,278,170	7,426,000	1,635,830	1,654,000	6,914,000	9,080,000
Germany	461,400	543,500	265,600	349,000	727,000	892,500
Switzerland . . .	28,240	47,510	71,580	64,400	99,820	111,910
Belgium	37,880	10,460	—	—	37,880	10,460
Total	£13,828,462	£14,847,676	£6,591,911	£6,520,543	£20,420,373	£21,368,219

* Including Egypt.

TABLE XXXIII—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO UNITED STATES OF AMERICA

(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . . .	£278,898	£481,108	£31,377	£21,825	£310,275	£502,933
U.S.A.	—	—	—	—	—	—
Germany	194,300	114,300	55,000	60,800	249,300	175,100
Switzerland . . .	86,600	32,280	66,200	59,800	152,800	92,080
Belgium	10,480	9,290	—	—	10,480	9,290
Total	£570,278	£636,978	£152,577	£142,425	£722,855	£779,403

TABLE XXXIV—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO SOUTH AND CENTRAL AMERICA

(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . . .	£1,080,728	£1,480,099	£600,815	£779,756	£1,681,543	£2,259,855
U.S.A.	4,289,000	2,660,640	1,959,000	1,369,360	6,248,000	4,030,000
Germany	1,235,000	1,516,000	896,000	992,000	2,131,000	2,508,000
Switzerland . . .	55,700	84,600	141,100	106,787	196,800	191,387
Belgium	172,300	101,000	30,980	24,550	203,280	125,550
Total	£6,832,728	£5,842,339	£3,627,895	£3,272,453	£10,460,623	£9,114,792

INTERNATIONAL ELECTRICAL EXPORT TRADE

TABLE XXXV—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO ASIA
(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . .	£729,635	£442,453	£505,833	£343,915	£1,235,468	£786,368
U.S.A. . .	1,770,100	1,392,000	764,900	649,000	2,535,000	2,041,000
Germany . .	750,000	929,000	598,000	596,000	1,348,000	1,525,000
Switzerland . .	67,020	74,100	154,800	169,000	221,820	243,100
Belgium. . .	35,570	28,080	—	—	35,570	28,080
Total . .	£3,352,325	£2,865,633	£2,023,533	£1,757,915	£5,375,858	£4,623,548

TABLE XXXVI—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO AFRICA
(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . .	£182,863	£101,365	£50,413	£75,656	£233,276	£177,021
U.S.A. . .	58,730	26,860	7,270	6,440	66,000	33,300
Germany . .	14,530	25,450	7,120	20,250	21,650	45,700
Switzerland . .	17,250	17,240	12,760	15,670	30,010	32,910
Belgium. . .	68,200	99,600	61,300	24,220	129,500	123,820
Total . .	£341,573	£270,515	£138,863	£142,236	£480,436	£412,751

TABLE XXXVII—ELECTRICAL EXPORTS FROM FIVE COUNTRIES TO EUROPE
(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . .	£1,688,585	£2,231,051	£978,004	£1,103,046	£2,666,589	£3,334,097
U.S.A. . .	1,485,000	3,537,700	517,000	706,000	2,002,000	4,243,700
Germany . .	8,071,040	9,659,750	5,538,210	7,487,950	13,609,250	17,147,700
Switzerland . .	977,400	1,310,200	648,470	1,006,473	1,625,870	2,316,673
Belgium . .	588,600	549,500	41,200	79,300	629,800	628,800
Total . .	£12,810,625	£17,288,201	£7,722,884	£10,382,769	£20,533,509	£27,670,970

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XXXVIII—ELECTRICAL EXPORTS FROM FOUR COUNTRIES
TO GREAT BRITAIN
(1927 and 1928)

Country.	Apparatus.		Machinery.		Total.	
	1927.	1928.	1927.	1928.	1927.	1928.
Great Britain . . .	—	—	—	—	—	—
U.S.A. . . .	£819,000	£906,800	£326,000	£295,200	£1,145,000	£1,202,000
Germany . . .	1,043,200	1,062,000	380,800	454,000	1,424,000	1,516,000
Switzerland . . .	136,600	54,800	33,850	20,540	170,450	75,340
Belgium . . .	174,400	268,500	32,800	53,800	207,200	322,300
Total . . .	£2,173,200	£2,292,100	£773,450	£823,540	£2,946,650	£3,115,640

it was found impossible to make these adjustments owing to the fact that the regional distribution makes it almost impossible to attempt such adjustments from country to country. This applies especially to Reparations deliveries in kind, but it is necessary, in assessing the value of the market, to take note of such deliveries, since they enter into trade and should, under normal conditions, form part of the demand open to all competing countries alike. It may be stated at once that the increase in the German figures is due entirely to Reparations deliveries in kind and to the system which forces the quotations for Reparations deliveries to be lower than those ruling in the world as a whole. The result has been that German exports have pushed forward according to a principle which is not far removed from dumping, with, however, the recognition that Reparations, as established under the Dawes Plan and now by the Young Plan, must be met to some extent by this unsound system.

Table XXX. proves quite clearly that the competitive strength of Britain is now greater than it was in 1913. The British percentage of the total exports from the five main competing countries rose from 23·4 per cent in 1913 to 31·4 per cent in 1927, but, owing to a rapid expansion in German and American exports, this figure fell to about 27 per cent in 1928, though it is still fairly satisfactory. In machinery alone, the British percentage was rather lower in 1927 at 30·7, while, in 1928, it was about 27·6 per cent. Here again a proviso must be made to cover the effect that the German classification of control and switchgear includes items which really belong to the electrical accessories and fittings category, with the result that the German figure is probably well over £1,000,000 in excess of what it ought to be. If allowance is made for this and for Reparations deliveries in kind, Britain is still the leading exporter of electrical machinery in the world, but British supremacy is being more and more seriously challenged by Germany, largely as a result of the

REPARATIONS—ANALYSIS OF EXPORT MARKETS

Reparations system. Viewed in this international perspective, the achievement of the British electrical industry since 1913 is not inconsiderable: it shows that the industry has been efficient in international competition at a time when other countries were enjoying unnatural advantages associated with currency depreciation and abnormally low labour costs. From 1927 onwards, the Reparations system has provided an additional unnatural interference with competition, more powerful than any other. This system has all the faults of dumping with little possibility of its being effectively countered by British action, since it is already sufficiently evident that the actual payment of Reparations can only be made as a result of artificial stimulation of German export trade.

To Table XXXI. Belgium has been added as being an active rival of Britain in some markets. In the succeeding tables a broad territorial distribution has been made—namely, the British Dominions and Colonies, North America excluding Canada, South and Central America, Asia, Africa, Europe, and Britain itself. We analyse in Appendix C the British Dominion market as based on import statistics. Table XXXII. shows, however, that the United States supplied in 1928 42·5 per cent of their requirements compared with 33·8 per cent in 1927, a very considerable advance, due almost entirely to exports of apparatus, the machinery position remaining unchanged. American activity covers predominantly Canada and Australia. Germany also showed an increase, mostly to South Africa, although even now its percentage is only 4·2. Britain supplied, in electrical machinery, 70 per cent in 1927 and 68·5 per cent in 1928, and, in apparatus, 58 per cent in 1927, with a heavy fall to 46 per cent in 1928. In electrical engineering the competitive position is strong, but in apparatus the penetration of the United States and Germany, largely because of mass and standardized production, has increased in intensity and will probably become even more threatening in the future. How much this position will be modified by economic changes in the future cannot be decided at this moment.

Electrical export trade to the United States of America must have very little interest for the main competing countries, owing to the high tariff walls raised by that country. The success of these tariffs in excluding imports is shown by the ludicrously small figure of £779,000 as the exports from all countries to this territory. The United States are, therefore, able to discourage successfully the principle of reciprocal trade, while they can indulge with impunity in the game of disposing of their surplus to the British Dominions with its effect in reducing prices to an uneconomic level. Next to the Dominions, South and Central America is of greatest importance outside of Europe, and it is in this area that Britain has been

EXPORT TRADE : WORLD COMPETITIVE POSITION

decidedly most successful during the last two years. The British proportion of the market for all goods rose from 16 per cent in 1927 to 24·8 per cent in 1928, machinery and apparatus sharing equally in the advance. Exports from Germany also increased, the German percentage being in 1927 20·3 and in 1928 27·4—a smaller rate of increase than Britain has shown. The United States, on the other hand, have lost ground seriously, their proportion falling from 58·7 per cent in 1927 to 44·3 per cent in 1928. South America has apparently ceased to be a preserve for the United States electrical manufacturers and is becoming a much more open market, but how far this situation will obtain in view of the recent activities of American power finance groups in South American Republics remains to be seen. The 1928 statistics do show, however, that, granted normal competitive conditions, the gradual weakening of the U.S.A. hold on South America is only a matter of time. The fall in American exports to South America is exactly equivalent to the increase in her shipments to the British Dominions and Colonies, and shows that, in the latter, imperial preference as a psychological factor has less importance than formerly. This development may be, of course, purely temporary, but, in view of the political relations between Great Britain and the Dominions, it can scarcely be regarded as reassuring. The total South American market, unlike the Dominions, showed a decline of more than 10 per cent during 1928.

In Asia, which has only half the importance of South America, Britain has been steadily losing ground, the most rapid advance being recorded by Germany. Thus, in 1927, Britain supplied 23 per cent of all electrical machinery and apparatus shipments, but in 1928 it had fallen to only 17 per cent, while the German proportion had risen from 25 per cent to 33 per cent, the total market declining by 14 per cent. In electrical machinery alone, the British percentage fell from 25 to 19·5 per cent, the market declining by 13 per cent. In value of shipments, the German figures also declined slightly, so that Germany has been advancing in electrical apparatus purely on a basis of price, and one would expect such a development in view of the mass-production methods and low labour costs ruling in the sections of the industry devoted to the manufacture of apparatus.

Africa, outside of the British Dominions and Possessions, although it has a very great potential value, has not yet reached the stage where it can be regarded as of serious importance from the electrical point of view. It is significant that, in electrical machinery, Britain should now supply 53·5 per cent and, in combined machinery and apparatus, 43 per cent, Britain being the leading exporter in every category. This would indicate that the increasing industrial expansion of Africa, which may be expected in the future, will probably bring to Britain

AFRICA—AN ANALYSIS OF THE EUROPEAN MARKET

a fairly high percentage of valuable contracts, Britain being already securely established.

Europe represents now the greatest market open to electrical manufacturers and has taken the place of the British Dominions and Colonies in this respect. The recovery of Europe as a whole is shown by the very large increase in exports from the five competing countries. They have moved from £20,500,000 in 1927 to no less than £27,671,000 in 1928, an increase of 35 per cent. In this increase, Britain has participated to the extent of £670,000, but Germany and the United States secured practically all of the advance recorded. German exports increased by £2,500,000 and American by £2,250,000. The reason for such an advance in the case of the United States may, on close investigation, be discovered in American financial penetration as represented by investment in public utilities accompanied by control, and, secondly, in the establishment of closer relations between the American manufacturing firms and European subsidiaries. America has been able, as a result of this penetration, to double its exports in the course of one year.

An investigation shows that the whole of this increase is to be found in telegraphic and telephonic apparatus, in cables and subsidiary equipment, the increase in heavy plant being small. One can, therefore, look on this American invasion of Europe as due to factors either beyond the control of the British manufacturer or beyond his range of interests. In machinery alone, Britain supplied 12·7 per cent of the market in 1927 and 10·7 per cent in 1928, while, in apparatus, its proportion fell from 13·2 per cent in 1927 to 12·9 per cent in 1928. For apparatus and machinery combined, the percentage in 1927 was 13·0 and in 1928 12·1 per cent. Reparations are undoubtedly responsible for the improvement in German figures, although, as we show later, German deliveries on Reparations account may only total £2,200,000 in 1929, but such deliveries cover a much higher volume of shipments, since they may cover entire contracts of which only a part is credited to Reparations account. Before discussing this matter in any detail, it may be advisable to dispose of Table XXXVIII.—namely, exports to Britain. This table shows that exports to Great Britain have only slightly increased and is in itself an indication of the effort that is being made here to meet foreign competition. The only increase of any importance which has taken place has been in the imports from Belgium, due to shipments of telegraphic and telephonic apparatus and cables. The imports from Switzerland in 1928 were less than half those of 1927.

Returning to Europe, it is interesting to single out countries which have shown the greatest advance since 1925. These are, in order of importance, Russia, Holland, Spain, France, Poland, Austria, Czecho-Slovakia, Belgium. In each of these

EXPORT TRADE : WORLD COMPETITIVE POSITION

cases, the value of the market has practically doubled since 1925; Russia has actually tripled her imports since 1925, and Germany has handled the greater part of this increase largely as a result of credits supplied by the German Government. If the Reparations countries—namely, France, Belgium, Poland, and Roumania—are alone considered, the increase in German shipments to them has been very great indeed and represents a considerable percentage of the German advance. In other words, the United States and Germany, through the use of finance in the case of the former and through the use of Reparations in the case of the latter, have been able to secure a very large percentage of the business done in Europe, which has been revived and brought again almost to full activity as a result of the facilities rendered available by London.

Even so, the British electrical manufacturer has not been pushed out of Europe altogether. He has even been able to secure a fairly high proportion of German imports; he has secured a dominant position in Greece, in Portugal, and in machinery has decidedly improved his position in Denmark and in Holland. He has also been able to penetrate into Bulgaria and is now active in Hungary. It is evident, therefore, that, with the elimination of artificial aids to competitive efficiency enjoyed by Germany and the United States, the British manufacturer could enter the European market and secure a much higher percentage than he has at the present time. Even now his proportion is not negligible and provides a foundation on which a rapidly expanding export demand could be built.

In Table XXXIX. we have given the value of the principal markets for the electrical manufacturers over the two years for which exact information is available. The decline in the Dominions market has been caused by a fall in exports to Australia, and in this decline every country shared alike. The most important markets in the world at the present time, in order of value, are Australia, Argentina, India, Great Britain, Holland, Russia, Italy, Japan, Spain, France, South Africa, Poland, New Zealand, Sweden, Austria, Belgium, Czecho-Slovakia, Switzerland, China, Denmark, Chile, Cuba, and Norway. Examination of the percentages given in the table shows that a fair degree of specialization takes place in these markets, but the markets in which Britain has had most to gain and most to lose are markets where it has to struggle with the United States, and the United States has constituted the greatest menace to the development of a strong British electrical export trade. Germany, of less importance in the Dominions, but strong in Europe, is slowly moving ahead in a number of South American republics, and is consolidating its position in Japan and the Dutch East Indies, but, outside of Europe, it has not yet appeared to be a dangerous rival. The struggle lies still between the

GREAT BRITAIN, GERMANY AND THE U.S.A.

TABLE XXXIX—INTERNATIONAL TRADE IN ELECTRICAL MACHINERY AND APPARATUS

(1927 and 1928)

(Sterling 000's omitted.)

Market.	Electrical Machinery and Apparatus.						Electrical Machinery.					
	Total Value.*		Value of Exports from Great Britain.		Percentage supplied by Great Britain.		Total Value.*		Value of Exports from Great Britain.		Percentage supplied by Great Britain.	
	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.	1927.	1928.
British Dominions and Colonies .	20,420	21,368	12,642	11,273	62.0	52.7	6,592	6,521	4,619	4,453	70.1	68.5
Holland	2,727	3,135	300	395	11.0	12.6	871	487	102	154	11.7	31.6
Russia	1,945	2,951	152	267	7.8	9.0	1,307	1,572	83	239	6.4	15.2
Spain	1,599	1,952	375	291	23.5	14.8	667	873	154	134	23.1	15.3
France	1,202	1,827	369	337	30.7	18.4	359	324	137	87	38.2	26.8
Italy	1,651	2,259	151	391	9.2	17.3	448	318	35	33	7.8	10.4
Poland	1,392	1,496	111	95	8.0	7.7	469	372	41	6	8.7	1.6
Sweden	1,286	1,467	79	108	6.1	7.4	365	163	18	16	4.9	9.8
Belgium	812	1,070	154	134	19.0	12.5	303	200	37	21	12.2	7.3
Czecho-Slovakia	728	1,003	17	14	2.3	1.4	280	248	—	5	—	—
Switzerland	747	981	107	95	14.4	9.7	219	124	18	23	8.2	18.5
Denmark	802	913	141	177	17.6	19.4	151	79	4	22	2.7	27.8
Austria	946	1,146	9	18	1.0	1.6	426	251	1	5	0.3	2.0
Norway	682	730	52	53	7.6	7.3	210	198	20	25	9.5	12.6
Roumania	565	688	118	138	20.9	20.6	169	206	32	51	18.9	24.8
Greece	329	633	3	31	0.9	4.9	171	147	1	8	0.6	5.4
Hungary	203	443	176	284	58.2	64.0	99	162	47	112	47.5	69.2
Yugo-Slavia	206	404	17	17	3.7	4.2	103	58	—	2	—	3.4
Portugal	523	356	—	—	—	—	124	53	—	—	—	—
Finland	244	285	87	100	35.6	35.1	80	78	12	22	15.0	28.2
Bulgaria	641	305	12	32	1.9	10.5	241	97	3	16	1.2	16.5
	103	142	—	23	—	—	38	34	—	—	—	—
Argentina	3,438	4,366	875	1,453	25.4	33.4	1,120	1,130	220	540	19.6	47.8
Brazil	1,930	1,785	335	305	17.3	17.1	794	587	180	129	22.6	22.0
Chile	889	801	195	247	21.9	30.8	373	169	69	42	23.9	22.2
Columbia	468	617	35	69	7.5	11.2	175	129	2	13	1.1	10.1
Mexico	1,289	1,314	136	120	10.6	9.1	448	372	30	58	6.7	15.6
Uruguay	273	260	35	31	12.8	11.9	63	44	11	13	17.5	29.6
Venezuela	326	306	32	19	10	6.2	128	78	22	6	17.2	7.7
Peru	292	221	34	29	11.6	13.7	144	71	10	9	6.9	12.7
Cuba	867	730	25	5	2.9	0.7	258	63	19	1	7.4	1.6
Japan	2,554	1,977	730	336	28.6	17.0	1,032	760	322	185	31.2	24.3
China	723	974	236	317	32.6	32.5	241	239	103	99	42.8	41.4
Dutch East Indies	664	687	31	48	4.7	7.0	207	142	7	8	3.4	5.6
Philippines	409	393	7	8	1.7	2.9	72	77	2	2	2.7	3.3
Siam	65	97	7	25	10.8	25.8	16	18	2	7	12.5	38.9
Persia	97	68	86	47	88.6	69.0	34	30	28	23	82.5	76.7
Turkey	146	166	11	7	7.5	4.2	90	35	—	2	—	5.7
Portuguese Africa	206	161	173	159	84.0	99.0	75	74	67	74	89.5	100.0
Belgian Congo	86	78	—	5	—	6.4	41	29	—	4	—	13.8

* Being the total of exports from Great Britain, U.S.A., Germany, Switzerland, and Belgium.

United States and Great Britain, and a further section of this chapter will examine the position with reference to these two important competitors in ten vitally important markets. Those markets are Australia, India, South Africa, New Zealand, Canada, Argentina, Brazil, Chile, Japan, and China. They represent the ten most important markets both for Britain and the United States, and in them the struggle has been intense for more than twenty years.

EXPORT TRADE: WORLD COMPETITIVE POSITION

IV.—BRITISH AND AMERICAN COMPETITION

In Table XL. the pre-war position from 1908 to 1912 and the post-war position from 1918 to 1928 have been shown for each market, exports from Great Britain and

TABLE XL—EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM GREAT BRITAIN AND U.S.A. TO LEADING MARKETS (*Sterling*)
(1908-1928)

Year.	India.		Australia.		South Africa.	
	Great Britain.	U.S.A.	Great Britain.	U.S.A.	Great Britain.	U.S.A.
1908	398,000	85,500	421,000	75,000	155,000	28,000
1909	432,000	34,500	430,000	54,000	309,000	45,500
1910	386,000	33,000	617,000	77,000	558,000	57,500
1911	423,000	31,000	995,000	111,000	480,000	69,500
1912	484,000	40,000	1,414,000	158,000	424,000	43,000
1918	463,000	211,000	253,000	755,000	296,000	168,000
1919	1,103,000	567,000	878,000	835,000	900,000	357,000
1920	3,219,000	878,000	1,525,000	926,000	967,000	383,000
1921	5,081,000	871,000	2,865,000	1,551,000	1,094,000	578,000
1922	3,077,000	346,000	2,114,000	993,000	595,000	122,000
1923	2,151,000	367,000	2,759,000	1,008,000	937,000	216,000
1924	2,030,000	236,000	3,468,000	1,180,000	1,799,000	316,000
1925	2,216,000	339,000	3,358,000	1,050,000	1,485,000	224,000
1926	2,527,000	442,000	4,596,000	1,565,000	1,558,000	290,000
1927	2,599,000	395,000	4,424,000	1,408,000	1,883,000	321,000
1928	2,818,000	536,000	3,264,000	1,370,000	1,150,000	408,000

Year.	New Zealand.		Canada.		Argentina.	
	Great Britain.	U.S.A.	Great Britain.	U.S.A.	Great Britain.	U.S.A.
1908	114,000	34,600	62,000	271,000	311,000	100,000
1909	133,000	11,700	129,000	308,000	329,000	91,000
1910	112,000	22,800	198,000	465,000	370,000	137,000
1911	152,000	13,200	204,000	670,000	379,000	111,000
1912	241,000	23,900	431,000	764,000	390,000	119,000
1918	68,000	223,000	62,000	2,440,000	71,000	450,000
1919	194,000	274,000	78,000	3,250,000	251,000	800,000
1920	475,000	415,000	310,000	5,230,000	552,000	760,000
1921	625,000	494,000	195,000	2,990,000	1,056,000	800,000
1922	527,000	195,500	232,000	2,091,000	489,000	508,000
1923	901,000	282,000	268,000	2,440,000	629,000	696,000
1924	1,175,000	289,000	425,000	2,941,000	685,000	575,000
1925	1,164,000	298,000	388,000	2,500,000	762,000	775,000
1926	1,198,000	454,000	425,000	3,290,000	1,233,000	963,000
1927	1,222,000	398,000	457,000	3,760,000	875,000	1,324,000
1928	1,022,000	320,000	478,000	6,200,000	1,453,000	1,432,000

GREAT BRITAIN AND U.S.A., THE DOMINION MARKET

TABLE XL—EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM GREAT BRITAIN AND U.S.A. TO LEADING MARKETS (*Sterling*)—(continued)

Year.	Japan.		China.		Brazil.		Chile.	
	Great Britain.	U.S.A.	Great Britain.	U.S.A.	Great Britain.	U.S.A.	Great Britain.	U.S.A.
1908	311,000	410,000	127,000	11,500	136,000	450,000	35,000	40,600
1909	425,000	305,000	103,000	8,000	211,000	304,000	58,000	14,600
1910	542,000	221,000	164,000	12,900	390,000	405,000	35,000	29,800
1911	435,000	460,000	85,000	16,600	296,000	505,000	64,000	55,500
1912	435,000	308,000	86,000	19,200	238,000	680,000	105,000	57,000
1918	31,000	840,000	55,000	308,000	35,000	615,000	21,000	655,000
1919	171,000	1,290,000	339,000	625,000	195,000	1,200,000	71,000	510,000
1920	452,000	1,537,000	520,000	860,000	312,000	1,230,000	110,000	297,000
1921	283,000	1,999,000	802,000	903,000	255,000	1,045,000	321,000	420,000
1922	582,000	2,610,000	537,000	361,000	207,000	402,000	356,000	415,000
1923	457,000	1,830,000	272,000	286,000	223,000	398,000	152,000	820,000
1924	888,000	2,715,000	219,000	193,000	276,000	690,000	186,000	390,000
1925	980,000	2,090,000	240,000	178,000	303,000	824,000	143,000	358,000
1926	595,000	2,210,000	250,000	226,000	291,000	885,000	302,000	1,044,000
1927	730,000	1,344,000	236,000	234,000	335,000	948,000	195,000	522,000
1928	336,000	914,000	317,000	405,000	305,000	1,008,000	247,000	349,000

the United States covering all electrical machinery and apparatus. In the Dominions, including India but excluding Canada, the British pre-war percentage of imports fluctuated round 90 per cent, while the United States supplied practically the whole of the remaining 10 per cent. In India, South Africa, and New Zealand, the United States made no headway from 1908 to 1912, and showed, if anything, a tendency towards decline; in Canada, it supplied a high percentage of market requirements during the five years in question, but, even here, Great Britain improved its relative position; in Australia, which showed remarkable expansion, Britain benefited more than the United States. The result was that, before the war, the United States was not a serious competitor of Great Britain, outside of Canada. Allowance must be made, in this connection, for the effect of trade agreements limiting competition between American parent firms and British subsidiaries. The injury done to British electrical export trade by the war years and the enormous advantages obtained by the United States in being able to meet the requirements of those markets without serious competition, can be seen from the post-war figures. In 1919, for example, American exports had risen to 50 per cent of the British exports to India, and the American share of the market was, therefore, 33 per cent. Exports to Australia were almost the same as the British totals, so that the American

EXPORT TRADE: WORLD COMPETITIVE POSITION

proportion had risen to almost 50 per cent. In South Africa, which has been distinguished by its close adherence to British products since the war, the American advance was not so marked, while in New Zealand a position similar to that obtaining in Australia was to be found. Britain lost the Canadian market almost entirely, and only in 1928 reached the level of 1912 exports.

From 1920 onwards, the British manufacturers were able to recapture a very large proportion of the trade lost during the war years, so that, in 1924, the American percentage in India had fallen almost to its pre-war level. In Australia it had declined from almost 50 per cent to less than 25 per cent in 1925. The expansion of the South African market had no effect on American exports, which showed a fairly steady movement of decline. In New Zealand, the progress of re-acquisition by British manufacturers was more prolonged and was ultimately less successful. In 1928, however, America moved upward again in every market, above all in Australia, Canada, and India, and is once more threatening the British position.

We reproduce in Appendices A and C two articles which survey the position in the Dominions over the period 1922-27, and it is hardly necessary at this point to comment on them. They illustrate very markedly the steady improvement in the British competitive position which took place during the six years in question, but the fall in the British relative position in 1928 has neutralized a great part of this advance. Much of the fall in Australia, for example, may be attributed to a fall in the total value of the market, and may be only temporary in nature.

In South America, the British manufacturer has, on the whole, maintained his position. Britain predominated in the Argentine in pre-war years, but lost ground very seriously as a result of the war. Since 1921, however, a fairly stable position has been reached where British and American exports are almost equal, but, in view of the determined efforts made by American manufacturers to gain control of public utilities in that market, it is doubtful whether in the future even this position of balance will be maintained. In Brazil, the U.S.A. always predominated, but here again the advantages obtained during the war period have not been altogether lost, so that the British competitive position in 1928 was decidedly weaker than in 1925 and showed no improvement on that of 1912. In Chile, which practically disappeared as a British market during the war years, Britain has not been able to restore the pre-war level, and one would hardly expect it to do so in view of the immense increase in American holdings in the copper mines and other industrial activities of that republic. Considering the difficulties under which the British manufacturer has been suffering in that market, his record in Chile is probably better than in any of the other ten markets mentioned.

BRITAIN AND U.S.A. IN S. AMERICA AND DOMINIONS

On balance, one can say that the British competitive position in every market was strong before the war ; it was almost destroyed by the war, and the process of recovery has been in a number of markets slow. Japan and Canada have gone over largely to the United States, in spite of the determined efforts made by British firms in the last four years to make an impression on these markets. Japan especially has gone over more and more to support of home production, and this, combined with financial difficulties, explains the heavy fall in both British and American exports which took place in 1928. One would expect, however, that in 1929 and the following years an improvement would set in.

Canada has come under the control of American finance as far as public utilities are concerned, and the result has been that Britain has played no part whatever in the enormous expansion which has taken place in that market, especially in 1928, when America apparently exported the total of £6,200,000. Reproduced in the Appendix is an article on Canada which explains the situation. Britain supplies about 2.1 per cent of Canadian electrical consumption, and, in view of the control exerted by American financial affiliated groups over electricity supply in that territory, even this small percentage must be considered as decidedly an achievement. Whether, in the future, the exports from this country can be increased remains exceedingly doubtful, but Canada, which has always adhered nominally to the principle of imperial preference, and, on the basis of such preference, has been able to expand its export trade to Great Britain, should show more effective illustration of its belief in the principle. It can do so by restoring straight competitive conditions in the electrical market without allowing political, financial, or other factors to interfere with the normal course of trade.

Australia is the most valuable market open to the British manufacturer, and the British position has not been seriously threatened since 1911. It is fairly clear that with certain fluctuations in percentages, owing possibly to the incidence of special contracts, Great Britain has been able to retain her position in the Australian market intact. We have thought it advisable to show the course of British electrical trade with that Dominion from 1911 onwards, in order to obtain some historical perspective. The position in Australia over seventeen years is shown in Table XLI. (page 104), where the growth of the market is shown with reference to the total imports, and the business done by Great Britain in electrical machinery in the total trade has been established both in value and in percentages. As we have already stated, the Australian market has grown in the most remarkable fashion, especially in post-war years, although a severe recession, which took place in 1928 and will probably be shown in the 1928-29 figures, has interrupted this advance. The British share of the total market has shown

EXPORT TRADE: WORLD COMPETITIVE POSITION

TABLE XLI—IMPORTS OF ELECTRICAL MACHINERY AND APPARATUS INTO AUSTRALIA
(1912-1928)

Year ending June 30th.	Total Imports.		Imported from Great Britain.		Percentage supplied by Great Britain.	
	Electrical Machinery and Apparatus.	Electrical Machinery.	Electrical Machinery and Apparatus.	Electrical Machinery.	Electrical Machinery and Apparatus.	Electrical Machinery.
1912	£1,562,010	£390,156	£942,883	£204,811	60·1	52·5
1913	1,981,535	506,460	1,240,384	241,870	62·5	47·9
1914	2,093,693	535,205	1,305,465	251,002	62·5	47·0
1915	1,593,058	478,323	1,017,185	209,761	63·5	43·7
1916	1,975,206	558,612	1,300,774	270,459	66·0	48·5
1917	1,717,169	532,590	1,083,324	217,169	63·4	40·7
1918	1,098,615	336,048	312,327	98,113	28·4	29·2
1919	2,301,743	593,417	564,519	208,452	24·4	35·2
1920	2,563,478	855,539	1,428,018	371,559	55·6	43·4
1921	5,317,165	1,896,811	3,333,590	1,087,416	62·6	57·2
1922	4,658,623	1,698,668	2,890,223	916,725	62·0	54·0
1923	4,720,534	1,623,705	3,072,736	951,708	65·0	58·5
1924	5,235,375	1,333,967	3,030,865	776,984	58·0	58·0
1925	6,312,816	1,580,286	4,334,343	1,127,003	68·5	71·4
1926	6,188,294	1,479,021	4,080,043	994,082	66·0	67·3
1927	7,272,377	1,615,381	4,675,293	963,480	64·4	59·5
1928	7,166,008	1,474,230	4,754,266	1,006,311	66·6	68·2

remarkably small fluctuations since 1912, if we except the three years during which the American invasion was at its height. In 1927-28 the British proportion was as high as 67 per cent, but, as the figures elsewhere show, there has been a fall in competitive power in 1928-29, so that no real change has taken place in the competitive strength of this country during the post-war decade. In machinery alone, there have been severe fluctuations; the British percentage fell steadily from 52·5 in 1911 to 43·7 in 1915, recovered sharply in 1916, and was affected by the overflow of imports from America during the late war and early post-war years. Since 1922 there has been a slight improvement in the British position, which indicates that, in this market, Britain has been able to recover entirely the ground lost during the war years. There is, however, the danger that American competition will be more successful in the future than it has been during the last few years, even if the movement towards decline in British competitive power which began in 1925 should have been arrested in 1927, above all in machinery where the British percentage rose almost to the 1925 record, 68·2 per cent against 71·4 per cent. One may perhaps distinguish certain cyclical fluctuations in Australian import trade and

AUSTRALIA—REPARATIONS AND EUROPEAN MARKET

elaborate definite theories from them regarding the growth of temporary rise and fall of demand, but Australia resembles the United States in that its economic expansion is fairly continuous. It is a rising market with very great potentialities indeed, and the British manufacturer may be expected to contribute to the realization of increased economic prosperity in the Dominion through industrialization based on electrical power. British power equipment is playing an increasingly important part.

Before discussing the main conclusions to be derived from this investigation of electrical export trade, one must examine the effect of two important developments in the position and prospects of British electrical exports. These are Reparations as affecting the European market, and power finance as affecting, above all, the South American market.

V.—REPARATIONS

In connection with Reparations, it is only necessary to quote the text of a Memorandum which has already been published by this Association. We give below the text as published, with modifications made to bring it up-to-date.

In a special publication issued in August 1926, devoted to "The Electrical Industry in Germany," we drew attention to the danger which Reparations constituted for British industry generally, and we gave it as our opinion that the technical difficulties of transfer, quite apart from general economic, political, and social considerations, would render necessary a further conference of experts in the winter of 1928 to study the Reparations problem. At that time the position, as far as the great exporting industries of Britain were concerned, could not be regarded as serious. Internal reconstruction and the growth of rationalization in Germany, some results of which we foretold in 1926, engaged all the energies of industrialists in that country and kept them out of the international competitive market. Now, however, the position is entirely changed. Rationalization is practically complete in the German iron and steel and electrical manufacturing industries, with the result that they are competing actively with the British industries, and are using every possible resource at their disposal to develop their export trade.

The whole question of Reparations has assumed, therefore, for the electrical industry an aspect which has ceased to be theoretical and has become urgently important. It is not our purpose to press for abolition of Reparation, although we are in substantial agreement with the statement which has been made in a recent survey of the German industrial position : *

* "Republican Germany : A Political and Economic Study," by Hugh Quigley and Robert T. Clark (London : Messrs. Methuen & Co., Ltd., 1925).

EXPORT TRADE: WORLD COMPETITIVE POSITION

"Germany, in order to pay reparations, without dissipation of fixed capital and the collapse of the mark exchange, would require to become the most prosperous and most active industrial country in the world, with a steadily increasing export trade yielding a large favourable balance, with industries superior in efficiency and marketing success to those of Great Britain, America, and France, with unlimited credit to finance transactions in the most distant markets, and with investments abroad of sufficient value to allow it to secure a strong hold on the economic development of many important markets. After this consummation had been reached, it would be possible for Germany to pay reparations, but they would be reparations won from the defeat and decline of the industrial countries that had emerged victorious in a military sense from the war. Under no other conditions could the Reparations problem be solved, and its solution would spell disaster, above all, for the industries of Great Britain."

The time has come, however, for every exporting industry in Britain to protest very seriously against the continuance of the principle of Reparations deliveries in kind. If the cession of such deliveries means the virtual surrender of the whole principle of Reparations, owing to the impossibility of transferring large volumes of money (under the full Reparations year, £100,000,000), then it would be better from the industrial point of view if Reparations were abandoned altogether. The damage to British export trade which has been caused in the past and will take place to a much greater degree in the future, more than outweighs any financial advantage accruing to this country from the payments of Reparations, or from the use of Reparations to meet the payment of certain foreign debts. In any case, it is not the concern of an industry to simplify matters merely for financial experts or to take account of finance when a policy affecting adversely its own economic prosperity is involved. We confine our observations purely to the electrical side of Reparations, but, as far as our observation goes, these considerations can be applied practically without change to other British exporting industries.

Under the various Reparations agreements, especially that concerned with the Dawes Plan, Germany is allowed each year to meet part of its payments on Reparations account by deliveries in kind. This means that, if the Reparations countries, which include Great Britain, Belgium, France (including Alsace-Lorraine), Japan, Greece, Italy, Jugo-Slavia, Poland, Portugal, Roumania, the French Colonies (notably the Cameroons, Togoland, Algeria, West Africa, Morocco, Madagascar, French India), the Belgian Congo, Portuguese East and West Africa, are willing to accept on Reparations account goods to the total value of their receipts under Reparations, there is no necessity then for the transfer of currency or other forms of direct financial payment.

In other words, German industry may use Reparations deliveries in kind as one of the most important weapons in its armoury for the development of its export trade and for entrance into markets that at one time were closed to it, and the list

THE EFFECT OF REPARATIONS DELIVERIES IN KIND

of possible markets, as indicated by the countries enumerated above, is sufficiently formidable. It covers some of the most important European markets, the only countries of importance omitted being Holland, Scandinavia, Spain, Russia, Czecho-Slovakia, Austria, and Hungary. Reparations, effectively administered, should be sufficient to allow the German industrialist to gain absolute control of the European market.

Examination of the total deliveries effected since 1925 is significant in this respect. In 1925 German Reparation deliveries amounted to almost exactly £26,000,000,* in 1926 to £31,600,000, in 1927 to almost £29,000,000, and in 1929 to £40,000,000, and of these, finished products alone accounted in 1925 for £6,360,000, in 1926 for £9,460,000, in 1927 for £8,490,000, and in 1929 for £17,000,000. To these totals, however, should be added products in the raw material and semi-finished group, which are in direct competition with British production. Among this class should be counted coal and its derivatives, mineral oils, cement, chemical products, iron and steel. If we add these items to the total of finished products, we find the value of Reparation deliveries in 1928, which can be regarded as directly competitive with British products, to be in excess of £30,000,000.

Electrical machinery and apparatus accounted for £450,000 in 1925, £750,000 in 1926, £670,000 in 1927, and £2,200,000 in 1929, judging from returns covering nine months. These statistics bearing on electrical machinery and apparatus do not appear to be very important when we consider that the total German electrical exports in 1928 exceeded £23,000,000, but the significance of the Reparations system as now practised by German industrialists is much greater than these statistics would suggest. In the first place, deliveries in kind are either exported free of import duties on the part of the Reparations country, or these duties are so reduced that they constitute a premium on German exports in competition with British or American.

If we take France alone we find that, on March 24, 1928, the French Government promulgated a law, which facilitated the execution of public utility works on a large scale with the assistance of deliverance in kind to be supplied by Germany, provided important administrative facilities for such works which could be authorized by decree, and the contracts for which could be approved by ministerial decision without reference to the French Parliament. There should be total or partial exemption from customs duties on products originating in or imported from Germany as deliveries in kind, where such products were to be used for works of

* The statistics used here are taken from foreign trade returns and not from the Report of the Agent-General for Reparations.

EXPORT TRADE: WORLD COMPETITIVE POSITION

public utility. Such legislation bears directly on practically the entire electrical imports of France, and it is sufficient to make France almost a closed market to the British electrical industry.

To take a concrete example: if a contract for a turbo-generator set composed of a turbine and alternator were placed open to tender on the part of British and German firms for a French supply undertaking, and the value of the contract were equivalent to £60,000, the German manufacturer could quote exactly the same as the British manufacturer—namely, £60,000—but he could deliver the turbine on Reparations account and the alternator on ordinary commercial account, and, in this case, the turbine would enter free of duty. The result would be that the French supply undertaking would find itself practically forced to take the German tender, owing to the premium granted to the latter by the exemption of half of the contract from import duties. The Reparations system, as worked out on this principle, is tantamount to partial and, in some cases, to complete abolition of import duties on electrical products exported from Germany to France and other Reparations countries where legislation similar to that promulgated in France is in force.

A further development of the principle can be found in the construction of a complete power station. If such a power station, including the structures and the equipment inside it, could be erected solely and entirely on Reparations account, the injustice to the British exporter would not be so great, since he would recognize that there is a definite limit to the volume of exports which can be delivered on Reparations account. When, however, as in the case of an entire generating station which may cost £600,000, for example, the deliveries on Reparations account may only cover the structure, and the remainder of the contract must be carried out on an ordinary commercial basis by the German industrialist, the position becomes much more serious. Electrical equipment is based on certain fundamental types which are not standard throughout Europe, or even throughout an entire national industry. Thus, it would be very difficult to instal equipment partially of German, partially of British, and partially of French design which would justify itself economically, and so the Reparations system is being used by Germany as a lever for moving entire contracts over to the German industry.

In the case of the power stations, for example, only 10 per cent of the entire capital expenditure may probably be directly attributed to the Reparations deliveries, the remaining 90 per cent being due to the German exporter in the ordinary course of trade. The result is that the German trade returns show Reparations at a certain small figure, when the real volume of exports caused by the Reparations system may be many times larger. To this fact we can attribute undoubtedly the very great

FRENCH RAILWAY ELECTRIFICATION CONTRACTS

increase that has taken place in the German exports of general machinery, electrical machinery, and apparatus.

From the point of view of international competition, the statistics of Reparations deliveries have more than a superficial significance ; they act as indications of a much wider movement in exports, due almost entirely to the Reparations principle. An examination of the German export statistics is sufficient to show that much the greatest relative increase has taken place in the category of finished products. In the last two years, 1927 and 1928, German electrical exports have moved up so rapidly that they now constitute almost twice those of 1926, the European market accounting for the greater part of the increase recorded.

A further possibility of expansion, which is now being developed by the German industrialist, lies in railway electrification, notably in France, and here again an entire electrification scheme may hinge on Reparations deliveries, which only constitute a fraction of the total value of the contracts. It is only necessary, for example, for the railway companies to adopt a purely German electrification system to be forced ultimately to obtain all their requirements from German firms. As a result, the delivery of Reparations in kind has given rise to a thoroughly vicious system, which is calculated, in the electrical industry at least, to narrow down the European market to the British exporter. This aspect of the situation should be considered by politicians, and even by financiers who, intent on solving the Reparations problem, have proclaimed the necessity for developing more extensively the export trade of Great Britain. These two propositions, as far as Reparations in kind are concerned, are mutually contradictory. As our experience in electrical manufacture has shown, Reparations grant a direct premium to German exports, and constitute an equally direct attack on the general prosperity and the export activities of the British electrical industry.

If we take definite examples of what is proposed to be done in France alone on the basis of this Reparations system, we can see how important the whole subject has become. In France the total public works contracts approved by the Transfer Committee during the first nine months of the fourth annuity year ending August 1928, were valued at £1,330,000, three water-power stations accounting for £590,000. The actual developments projected on a Reparations basis in France cover five generating stations—namely, Cure (6000 KW.), Truyère (66,000 KW.), Marèges (23,000 KW.), Kembs (60,900 KW.), and Vrach (11,000 KW.). These stations, if they were entirely carried out by German industrialists, would represent contracts ranging between £4,000,000 and £6,000,000, part of which might, under normal conditions, have been carried out by the British exporter.

EXPORT TRADE : WORLD COMPETITIVE POSITION

Again, the *Chemins de fer du Midi* has arranged with the French Government for the electrification of a further 1100 kilometres of its main lines, and, in this case again, the greater part of the work will be carried out nominally on a Reparations basis. For this new stretch two firms are concerned, the *Siemens-Schuckert* combine of Berlin and the *Constructions Électriques de France*, the contracts for rolling stock covering 100 electric locomotives and 15 motor coaches. According to agreements made, the Maffei works of Munich will supply the mechanical parts of 60 locomotives, the traction motors for these locomotives, the casings and the winding materials for the remaining 40 locomotives to be supplied by the *Constructions Électriques*. Again, the *Siemens-Schuckert* combine will supply the air-compressor motors for all the hundred locomotives and all the motors required for the fifteen motor coaches. The capacity of each electric locomotive is designed as 1400 H.P., so that, on a horse-power basis, the total capacity of the entire order will be in the vicinity of 150,000 H.P.

This order constitutes a direct penetration of a market in which British firms were interested, since a great part of the materials used for the previous electrification schemes of this railway were supplied by British firms. The Reparations system has been used here by German industrialists to force the British manufacturer out of an important market. The total cost of the Midi scheme has been estimated at 500,000,000 francs (£4,000,000), rolling stock accounting for 320,000,000 francs, and the transmission and distribution systems for 180,000,000 francs. Again, in the *Paris-Lyons-Méditerranée* Railway, plans are now far advanced for the electrification of the Riviera lines, extending from Marseilles to Ventimiglia, which is calculated to cost 700,000,000 francs, and will also be carried out in part at least on a Reparations basis.

In other Reparations countries we can find similar schemes either under survey or actually under construction. Thus, in Jugo-Slavia, the development of the national telephone system has been carried out partially by German firms on Reparations account and will be extended; while, in Belgium, telephone cables extending from Brussels to the German frontier have been laid on exactly the same principle. Examination of the statistics of German exports to the leading Reparations countries during the years 1925-27 shows that, in the case of France and Jugo-Slavia, deliveries in kind have actually been greater than the total of exports on a general commercial basis, while in Belgium and Roumania they constitute a substantial percentage of the total.

Since this Memorandum was written, a further development has taken place in connection with what has been known as the Young Plan. This plan has, as

YOUNG PLAN & INTERNATIONAL REPARATIONS BANK

far as we can understand, been abandoned, but its main provisions were of peculiar significance for the British electrical industry. They covered two things :

- (1) Reparations deliveries in kind ;
- (2) The formation of an International Reparations Bank.

Under the new system as proposed, Reparations deliveries in kind were to be reduced from their present total of about 800,000,000 marks to 600,000,000 marks in the first year, with a further reduction of 50,000,000 marks per annum for ten years, when they would disappear. If, however, transfer difficulties arose at the end of that period, Germany would have the right of claiming a re-survey of the situation, with the possibility of reimposition of the system of Reparations deliveries in kind, so that, to all intents and purposes, the latter formed a permanent part of the Reparations agreement.

We have, in the previous section, indicated the real significance of such deliveries, but under the new plan a further danger was added, through the circumstance that such deliveries could be re-exported by the countries receiving them. This would mean, for example, that a French firm with a limited productive capacity could tender in a neutral market such as the Argentine for an entire power plant installation and use German Reparations deliveries to carry out the contract. French industry, which has still only a limited productive capacity in engineering and electrical manufacture, could therefore make use of the much more extensive productive capacity and experience of Germany to develop a large export trade. A similar observation applies to Italy and Belgium. The new system was therefore, calculated to bring new competitors into the international competitive field; and the fact that in this system preference should be given to works of public utility aimed directly at British electrical export trade. The system as proposed merely formed part of the American-Continental electrical advance.

Again, the International Reparations Bank would have been empowered to grant short-term and other credits to countries and customers receiving such Reparations deliveries in kind, either directly or indirectly, and, in this case again, emphasis was laid on public utilities, so that this Bank would have as one of its main functions the financing of Continental export trade in direct competition with British. The Bank could also use its resources to develop new markets, especially in areas capable of rapid industrial expansion, and these areas, as an economic map of the world shows, are to be found entirely in the British Empire. Not content, therefore, with reducing through Reparations the British share in the European market to the advantage of Germany and, to some extent also, of America, which has been

EXPORT TRADE : WORLD COMPETITIVE POSITION

working in close association with electrical manufacturing firms in France, Italy, and Belgium, the Young Plan proposed to facilitate penetration by such competing countries into the British Dominions and Colonies and to permit of the exploitation of neutral markets such as South America through the Reparations system.

Since the prices paid for Reparations deliveries are invariably the lowest ruling in the international market, the Young Plan would have meant the introduction of a vast dumping policy into world trade, would have destroyed at one blow all reasonable conditions of tender, and would have destroyed permanently the balance of international competition. Against such a development the British electrical exporter would have been almost helpless, and it is therefore a matter of congratulation for the industry as a whole that the British resistance to the Young Plan was strong enough to render this whole policy abortive, and introduce a clearer sense of realities into the situation.

VI.—POWER FINANCE

In power finance, we have already shown in our special study—namely, “Combines and Trusts in the Electrical Industry”—how important this economic weapon has been, and we have indicated possible lines of development in the future. The following quotation illustrates to some extent the main principles at work in this development :

“It has been a characteristic of the electrical manufacturing industry in the main competing countries, ever since those early years, that it should have widespread financial ramifications and should depend for much of its activity on the wise use of financial power. Certain theorists have looked on the combination of finance and production as economically unsound, and have shown that the banks and other financial institutions should have been allowed to develop finance and leave production to the manufacturer. Others have looked on the system as one directed wholly against the consumer : in fact, as a vast international conspiracy to bring an essential public utility into the hands of a few groups with unlimited powers, groups against which legislation of the Sherman anti-trust type would be futile.

“The answer to these theorists is, of course, that few banks speculate on technical changes in the early stages of development ; they finance, as a rule, undertakings with a long dividend-earning past behind them and a fairly certain future before them, and they adhered closely to this rule in the case of electricity supply. It is only now, thirty years after the industry began to open out, that electricity supply securities are considered sufficiently safe to merit confidence and a high degree of credits from the banks. It is possible now to procure capital in the open market or advances from the banks for development of power undertakings without serious difficulty, but during thirty years the electrical manufacturer, assisted by special finance concerns, has been responsible for the greater part of the capital resources made available for the generation and distribution of electricity. This observation applies more particularly to countries like the U.S.A., Germany, France, Italy, Switzerland, and Belgium, where public companies are responsible for almost the entire national output of electricity. Economic causes have been responsible for

FOUR MAIN METHODS OF POWER FINANCE DEVELOPMENT

the rise to power of a small number of international power finance groups—largely a post-war growth—and not the concerted action of individuals or industrial concerns to secure a firm grip on the market. The great electrical manufacturing firms of the United States and Germany, especially the *General Electric Company* and the *Allgemeine Elektrizitätsgesellschaft*, created and financed electricity supply companies in the United States, Germany, South America, Italy, China, and Japan, not merely with a view to consolidating the market available for their products, but to preparing conditions suitable for the introduction of electrification of manufacturing processes in industry.

“In the early years the power companies were under the control, as far as capital and administration were concerned, of the electrical manufacturing concern, but as supply companies came more and more rapidly into existence, special investment and finance trusts were formed, still under the control of the manufacturer, to secure a grip on supply companies and participate in the development of new territory. Thus the manufacturer, through direct participation or through the power finance trust, was able to cope with a rapidly expanding market and ensure success in overcoming competition which might arise. Again, the great American and German firms placed subsidiary companies, notably in France, Italy, and Belgium, which carried out exactly the same policy as the parent firms, and so created strong markets for the products of the latter. To this must be ascribed undoubtedly the high proportion of the world’s export trade in electrical machinery and apparatus held by Germany before the war, and the inability of the British electrical manufacturer to gain an entrance into German, American, Eastern, and South American markets. His potential customers in the latter were already under the control of American or German competitors.

“We may make here some distinction between the various methods by which financial penetration was carried out, since it may serve as a basis of explanation for development noted in detail later on. Four main methods may be seen at work, sometimes adopted in isolation, sometimes in combination :

- (a) Interlocking directorates, where the controlling firm is represented on the board of directors of the subsidiary or associated firm by a director nominated by it or, in certain cases, by the chairman. It is not always necessary for the controlling firm to hold the majority of the ordinary shares or more than sufficient to maintain its representation.
- (b) Direct administrative and technical control through retention of all or the greater part of the ordinary share capital, either directly or through a subsidiary manufacturing or financial concern.
- (c) Direct technical control through the supply of manufacturing information and patent rights in the case of electrical manufacture, or through technical and financial advice in the case of an electricity supply company. Financial and power securities corporations associated with the electrical manufacturers may act as consulting engineers, nominally in an independent capacity, and divert orders to associated firms.
- (d) Association of banks with manufacturing concerns and with supply companies at the same time, where no connection exists apparently between the latter, may mean allocation of orders to the manufacturers, merely through the circumstances that the bank may desire to realize greater security for its holdings both in supply and manufacture. This aspect of financial penetration will be discussed later in the chapter devoted to the banks and their influence on combines and power trusts.

“Interlocking directorates have characterized associations of power finance groups, either with each other or with electrical manufacturing concerns, and community of interests can generally be proved through this fact alone, although officially and in public the statement is made that such concerns are

EXPORT TRADE : WORLD COMPETITIVE POSITION

wholly independent. We could scarcely expect the director of one company to serve on the board of a competing company or of a company controlled by hostile groups. The manufacturing control firms employ both methods—namely, direct representation and capital participation—to ensure effective representation in associated or subsidiary undertakings. Capital participation may be facilitated, especially in countries like Belgium, where company legislation is fairly elastic, through the creation of special founders' shares of limited total value carrying voting rights outweighing the rights of all other forms of capital, or, as in the United States, through the issue of preferred shares bearing with them the claim to a number of common stock shares of no par value. In these cases, executive control can be effected with little capital outlay, the real capital being furnished by debentures and bonds."

VII.—SUMMARY

We have examined in very close detail in this chapter the export trade of Great Britain and have indicated what, in our opinion, constitutes the significance of exports generally in the economic life of the country. There is, of course, the danger of attaching too much importance to export development, and it is essential in this connection that some sense of proportion should be maintained. Electrical exports, taking world production as a whole, do not represent a very high percentage of the total production in any country other than Great Britain and Sweden. Thus, we have shown, for example, that against a production of about £84,000,000 in 1928 exports accounted for £18,500,000, equivalent to 22 per cent. In electrical and allied machinery alone, exclusive of apparatus, exports accounted for about 33 per cent. In the United States, exports accounted for £18,910,000 out of a production of £336,000,000, or 5·6 per cent; in Germany, £19,500,000, out of a total production of about £120,000,000, or 16·3 per cent; in Sweden, £3,250,000, out of a total production of £6,500,000, or 50 per cent; while the corresponding percentage for France would be about 15 per cent, and for Italy rather less than 12 per cent. Sweden alone, of all the countries mentioned, has a higher export percentage than Great Britain, and this has been due, above all, to the restricted nature of the Swedish market.

It is true, therefore, that the home market represents a very important factor in production and in the definition of competitive efficiency. It is obvious that manufacturers who, as in Germany, can cover almost 74 per cent of their production at home can afford to export at much narrower margins than manufacturers in Britain, who must depend on 67–68 per cent. The United States percentage forms so small a proportion of the whole that exports constitute a genuine surplus and may be developed purely for special purposes without reference to any return on capital invested. Under those conditions, which make for absolute disparity between the

BRITISH AND AMERICAN AVERAGE PRICE LEVELS

basic factors governing competitive strength as they obtain in the competing countries, the British manufacturer must effect some adjustment in prices so that the return on his entire output, including exports, will be sufficient to justify enterprise and ensure a reasonable return on capital. Struggling against competitors who are exporting a surplus and are not dependent to any great extent on the acquisition of profits from such a surplus, and adversely affected by purely open market conditions at home, the British electrical industry has been working on very narrow margins indeed, and these margins are contracting steadily year by year. It is only necessary to look at the table on page 57 to see how very definite this process has become.

The main question to be decided is, therefore, that of the conclusion or continuation of this process. Have we any reason to believe that the British competitive position must still be strengthened through a reduction in prices, or have British prices come down to a world level? We have no reliable data which can be used for purposes of comparison other than information contained in the American Census of Production for 1927. The position, according to this Census, is summarized below :

PRICES OF AMERICAN ELECTRICAL MACHINERY PRODUCTS

Classification.	H.P. or KVA.	Total Value.	Average Price per KVA. or H.P.
A.C. turbo-generators	1,848,167 KVA.	£1,800,000	£0.975
A.C. generators, synchronous condensers and frequency changers	1,783,904 "	1,970,000	1.110
D.C. motors above 1 H.P.	635,130 H.P.	3,250,000	5.120
Induction motors up to 200 H.P.	3,168,705 H.P.	7,275,000	2.290
Induction motors over 200 H.P.	444,380 H.P.	539,000	1.190
Synchronous motors	636,692 KVA.	964,000	1.510

An examination of British average prices would show that the American level ranges between 12 and 30 per cent above the British, so that the British prices are evidently below the American and are probably also on a level with German and French. One can therefore conclude that the main tendency in the future will not be towards reduction in price so much as towards stabilization or even a slight increase. In the engineering branches of the industry especially, the fall in prices that has taken place since 1920 has been neutralized by economies in production, such economies being illustrated, above all, by an increase in labour efficiency. It is obvious that, at some time or other, the process must reach a critical point where volume must increase very considerably, manufacturing load must improve, and the decline in prices be either considerably slowed down or arrested altogether.

EXPORT TRADE: WORLD COMPETITIVE POSITION

One is inclined to the opinion that this critical point has now been reached. Economies will not be so great or so far-reaching in the future as they have been in the past, and there are indications that in world production the period of adjustment has come or is coming to an end. In other words, the British manufacturers are entering on a new phase of activity in exports, and it is a phase which must coincide with the employment of resources additional to or in substitution of those inherent in a policy of price-cutting—resources which are to be found in the more widespread and effective use of financial reserves and credit facilities, the more determined examination of market possibilities, and in the use of a more thorough educative and publicity campaign overseas into the value of British products. Combined with this, of course, must come initiative in technical construction and design, and this initiative depends, above all, on research and on development expenditure. It also depends to some extent on the training of a personnel capable of initiating technical changes and on the more exact study of market conditions on the part of the executive. The advantage will lie in the future with the country or the firm which can maintain technical initiative and, at the same time, be able to assess with some accuracy the economic value of the markets available in the world.

We have shown that the British electrical export position is fairly strong, in spite of the adverse effects of developments beyond its control—developments such as Reparations and the world-wide erection of prohibitive tariffs, allied to various forms of State subsidies, direct or indirect, adopted in certain competing countries. Great Britain as an electrical exporting country only dates from about 1911, the year the *British Electrical and Allied Manufacturers' Association* was formed, and its first real period of expansion covers the years 1920–27. Since 1927 the curve of progress has become horizontal, but there are indications that it may rise again slowly. One can assume with some justification that the need for developing exports will become less insistent as the home market in Britain expands, since, of course, this market has been subnormal ever since the conclusion of the war. Such an expansion might be expected on conclusion of the construction period in the national interconnection and main transmission scheme.

During the last two years the British position has been less favourable than it was in 1925 and 1926. German exports have been largely increased through the influence of Reparations, and American exports have benefited from the capacity of the manufacturer to embark on new manufacturing lines, obtain a sufficient market at home to justify large-scale production, and finance developments and propaganda work overseas. The result has been that the American strength has been exerted more in the direction of apparatus outside of the engineering group

EXPORT STATISTICS OVER CRITICAL YEARS 1927-28

than in heavy plant. The engineering side of the industry is decidedly more powerful in competition than the apparatus section, and the picture presented by the whole industry as a competitive unit is extremely patchy. Until the home market expands considerably, there is little real prospect of exports in small apparatus expanding against German and American competition.

An examination of the export statistics for the main competing countries during the two critical years, 1927-28, shows that Europe has recovered very rapidly and is probably the most active market as a whole in the world, not excluding the United States. Such activity can be attributed to the reorganization of industry and the extension of public utilities financed by American capital. The Dominions, which, as Appendix C shows, expanded more rapidly from 1923 to 1927 as markets for electrical products than the world as a whole, have temporarily at least reached a point of stability, but in the Dominions themselves there has been a change in the balance of trade. Thus, India is moving up rapidly again, accompanied by New Zealand at a slower rate of growth. Australia has apparently reached a period when previous capital expenditure has still to be entirely productive. Canada has gone over almost entirely to the United States, while the Irish Free State has shown a greater preference for the British product and, as a result of the Shannon Scheme, is expanding very rapidly its demand for equipment. Outside of the Dominions, the Federated Malay States is decidedly the most interesting, owing to very large schemes carried out during recent years. Outside of Europe and the Dominions, which between them account for 66 per cent of the world demand, South America is most important, but the market here has not expanded to the extent that one would have expected. It may be almost characterized as stagnant. Some explanation of this can possibly be found in the acute capital shortage and in the unfavourable world market conditions ruling for agricultural products such as wheat and coffee. A revival in the world demand would undoubtedly bring with it a rapid expansion of South America as an electrical market. The Asiatic market, excluding India and other British possessions, has shown the same tendency as South America. This has been due, above all, to political disturbances in China and severe financial deflation in Japan.

In general, however, the world as a whole does not betray any marked movement towards electrification outside of Europe and the Dominions, and it is in this comparative stagnation that the great opportunity of the British electrical manufacturer should be found. South America, Asia, and Africa are awaiting the expenditure of new capital on essential development schemes, and it should not be impossible for the British manufacturer, either acting through power finance or

EXPORT TRADE : WORLD COMPETITIVE POSITION

through the machinery of the Trade Facilities Act, to supply that capital and take the initiative in opening up those markets which were lost during the war period. It is obvious that the American capital export has not yet begun to affect the state of world electrical demand, so that the position is not altogether hopeless. In the power to combine manufacturing enterprise with financial resources lies the hope of increased electrical export trade for Great Britain.

ORGANIZATION AND GROWTH OF THE HOME MARKET

CHAPTER IV—ORGANIZATION AND GROWTH OF THE HOME MARKET

I.—THE SIGNIFICANCE OF THE HOME MARKET

IN the previous chapter, the position in the export market was analysed minutely on the basis of the information at our disposal, and certain recommendations were made regarding the possibility of developing this market more effectively in the future. The assumption is, of course, that the expansion of electricity supply and of electrical power consumption in overseas markets is primarily a matter for public authorities, private companies, and industrialists located in those territories, while the British manufacturer would supply the necessary equipment to make good such expansion and to implement important national power schemes. Some acceleration could be given to such development through the use of long-term credits and through the allocation of financial resources, either directly or through the medium of the power finance corporation.

The very importance of the power industries and the immense capital already expended in them preclude active co-operation on a large scale in the extension of power production facilities. Thus, a recent estimate gave the total capacity of all generating plant in the world as 95,000,000 kilowatts, representing a total capital expenditure of about £4,750,000,000, while the annual rate of increase has been given as between 9,000,000 and 10,000,000 kilowatts, representing in themselves alone an expenditure on electricity supply, as apart from power consumption, of not less than £500,000,000 to £600,000,000 per annum. The United States represent about 40 per cent of this total, so that the rest of the world requires financing to the extent of at least £300,000,000 per annum.

These figures are largely tentative, and may err on the conservative side, but they do show that, for any large manufacturing group in any country to secure a strong grip on world trade through finance, enormous resources, much larger than those at present available, would need to be used. It is true, of course, that the total of electrical export trade of all the exporting countries lies now in the vicinity of £80,000,000, but the task of financing power development is much greater than this, owing to the fact that the electrical section of any scheme represents a comparatively small proportion of the total capital expenditure. We have shown that power finance as a weapon can be used in a number of markets to shift the balance of trade from one country to another, but it can scarcely ever dominate all the power plant

ORGANIZATION AND GROWTH OF THE HOME MARKET

requirements of that market. The electrical manufacturer in export trade is confined mainly to the supply of equipment to carry out schemes initiated by authorities in the markets in question.

When, however, the second and much more important source of demand for electrical equipment is considered—namely, the home market—a new set of values emerges. The electrical manufacturer may, of course, confine his activities in this case again to the supply of plant and material for schemes already initiated. His rôle becomes, therefore, purely passive, and his policy becomes largely one of *laissez-faire*. His output rises and falls with the state of production and demand in electricity supply. If, however, he is of opinion that such a passive rôle is no longer justified and decides to contribute as much as possible to the acceleration of electrical power consumption, then the entire situation changes.

In recent years, largely through the central association, the electrical manufacturing industry in Great Britain has played an increasingly important part in accelerating demand and in creating for itself a market which might otherwise not have eventuated for a number of years. The justification for such a policy is obvious. On three grounds at least, the electrical manufacturing industry can base a case for active intervention.

(1) It is already clear that electricity has become in every country in the world the main source of power for manufacturing processes, for illumination and for commercial activities where machinery is used. It has still to justify itself, to some extent, as a heating agent. The result of electrification on a large scale in industry has been to render production much more elastic, much more automatic in system and in product, and much more reliable in quality. The result has been that industrial efficiency has increased, output per unit of plant and per employee has expanded, costs have come down and manufacturing capacity per unit has improved. It is possible to measure national industrial efficiency and national success in competition almost as a ratio of the state of electrification, and it is now generally recognized that electrification must be carried out on a very large scale if Great Britain is to resume its leadership among the main manufacturing and exporting countries. In contributing towards the recognition of this truth, in creating a demand for electric equipment, and in facilitating conversion to electric drive, the electrical industry is not only rendering a service to itself, but it is also improving the national economic position.

(2) The industry itself is now of sufficient importance to be classified among the basic industries. It employs directly more than 180,000 workers; it is almost entirely independent of imports of raw materials, with the exception of copper and mica; it comes at the end of a long series of industries beginning with coal and iron ore, and increased activity in it means increased activity in almost every industry in the country. Any effort the electrical manufacturers make to increase their output through the stimulation of electrical power consumption and the use of electric drive has its repercussions in industry generally, and is a direct contribution to increased employment both of labour and capital.

(3) Of less importance than the reasons already mentioned is that of reduction in power costs.

DEMAND ACCELERATION IN THE HOME MARKET

Electrical power production is dominated by the fact that a very heavy initial capital expenditure is required before production takes place at all, and the rate of capital turnover is probably the lowest of any industry in the country. The result is that power plant must be operated at a very high continuous rate if capital and overhead costs are to be reduced, and such a development can only take place with an increasingly active demand which lies in a steady upward movement in output per unit of plant installed. A reduction in power costs resulting from improvement in load factor bears on every industrial plant and is a factor in increasing industrial efficiency.

The problems to be met in the home market, if a purely passive attitude is to be abandoned, are, therefore, somewhat different from those already indicated in export trade. The home market can be stimulated by the efforts of the manufacturers themselves, just as it can be retarded by lack of enterprise on the part of the electricity supply undertakings. It is not our purpose at this point to describe the activities of the electrical manufacturing industry and its central association in stimulating demand for electrical power. The best example of co-operation in this respect is to be found in the national power scheme initiated by the Electricity Supply Act of 1926, legislation which was supported and advocated and undoubtedly accelerated as a result of the efforts put forward on behalf of the electrical manufacturing industry.

In examining the home market, one can distinguish between three sections, in line with the argument already adopted :

- (1) The value of the power market available in this country and the limits of economic expansion one would expect from it.
- (2) The national power scheme as the principal element governing expansion in the future.
- (3) The possibilities of accelerating the national scheme, through the introduction of more complete electrification in industry, agriculture, traction, commercial and domestic activities.

Such a distinction renders it possible to obtain some conception of the economic future of this country, since it is inevitably bound up with the progress of electrification and electrical power consumption. In this chapter we shall deal with the first—namely, the growth of electricity supply.

II.—THE GROWTH OF ELECTRICITY SUPPLY

An exact survey of the power situation is rendered difficult owing to the scarcity of statistics prior to 1920. Since 1920, largely through the activities of the Electricity Commission, fairly complete information is available regarding public supply undertakings, while the Census of 1924 allows us to obtain a national view, including private industrial plants. In addition to this, information is available

ORGANIZATION AND GROWTH OF THE HOME MARKET

regarding the output of power plant since 1920 as supplied by firms covering about 92 per cent of the output of the country. It is possible, therefore, to bring the Census figures of 1924 back to 1920 and forward to 1928. In certain years the total figures given may be slightly out of phase, owing to the inclusion of a percentage of additional plant in one year which is not installed but in process of manufacture and vice versa. Over the period of years, however, the picture given is almost entirely accurate. National statistics of generating plant are available for the years 1907, 1912, 1924, but 1907 and 1912 were not so fully covered as 1924, with the result that direct comparison is not accurate in every detail. The three years give a comparatively reliable survey of tendencies, even if the figures cannot be taken as absolute. The position from 1907 to 1924 is shown in Tables XLII-XLVI.

From 1912 to 1924 the increase in electrical power plant has been of the order of 142 per cent, equivalent to 12 per cent per annum, based on a straight average. As we shall show later, the increase from 1924 to 1928 was 36 per cent, equivalent to 9 per cent per annum, so that one would assume from this that the demand for electrical power is slowing down. This, of course, is not correct, since in the last four years much greater volumes have been under consideration. Thus, the average annual increment in plant from 1912 to 1924 is about 317,000 kilowatts, but from

TABLE XLII—GROWTH OF GENERATING RESOURCES, 1907-1924
(From Census of Production Statistics)

Industries.	Capacity of Electrical Generators Installed.					
	1907.		1912.*		1924.	
	KW. (millions).	Per cent.	KW. (millions).	Per cent.	KW. (millions).	Per cent.
Electricity supply	1·002	58·9	1·454	53·8	3·943	60·6
Mines and quarries	0·111	6·5	0·372	13·8	0·839	12·9
Iron and steel: engineering and shipbuilding	0·246	14·4	0·340	12·6	0·663	10·2
Textiles	0·077	4·5	0·165	6·1	0·273	4·2
Food, drink, and tobacco	0·026	1·5	0·370	13·7	0·077	1·2
Paper, printing, etc.	0·026	1·5			0·093	1·4
Building and building materials	0·020	1·2			0·079	1·2
Public utilities (other than elec- tricity supply)	0·123	7·2			0·257	3·9
Other groups	0·073	4·3			0·283	4·4
Grand total	1·704	100·0	2·701	100·0	6·507	100·0
Total (excluding electricity supply)	0·702	41·1	1·247	46·2	2·564	39·4

* The figures for 1912 are incomplete in respect of certain trades.

THE GROWTH IN ELECTRICAL GENERATING RESOURCES

TABLE XLIII—GROWTH OF PRIME-MOVER CAPACITY, 1907-1924
(From Census of Production Statistics)

Type of Prime Mover.	Capacity of Prime Movers Installed.					
	1907.		1912.*		1924.	
	H.P. (Millions).	Per cent.	H.P. (Millions).	Per cent.	H.P. (Millions).	Per cent.
Steam turbines	0·523	5·0	1·450	13·2	6·719	40·9
Reciprocating steam engines	8·981	86·6	8·624	78·8	8·300	50·6
Internal combustion engines	0·657	6·3	0·751	6·9	1·196	7·3
Other and unclassified	0·213	2·1	0·124	1·1	0·204	1·2
Grand total	10·374	100·0	10·949	100·0	16·419	100·0
Total (excluding electricity supply)	8·842	85·2	8·875	82·1	11·037	67·3

* The figures for 1912 are incomplete in respect of certain trades.

TABLE XLIV—ANALYSIS OF GENERATING PLANT INSTALLED, 1907-1924
(From Census of Production Statistics)

Type of Prime Mover.	Capacity of Generating Plant Installed.					
	1907.		1912.*		1924.	
	KW. (Millions).	Per cent.	KW. (Millions).	Per cent.	KW. (Millions).	Per cent.
Steam turbines	0·346	20·3	1·019	37·7	4·811	73·9
Reciprocating steam engines	1·251	73·5	1·407	52·1	1·275	19·6
Internal combustion engines	0·107	6·2	0·275	10·2	0·331	5·1
Other and unclassified					0·090	1·4
Total	1·704	100·0	2·701	100·0	6·507	100·0

* The figures for 1912 are incomplete in respect of certain trades.

1924 to 1928 it was almost double at 590,000 kilowatts, while the average over the eight years 1920-28 was 494,000 kilowatts, so that, in actual volume of demand, expansion has not only been steady, but it shows every indication of rapid acceleration as time goes on.

Examination of statistics of the total power equipment, including all machinery driving manufacturing processes electrically or otherwise, shows that electricity supply has been responsible for almost all of the increase reported from 1907 onwards. Thus prime-mover capacity rose from 10,374,000 H.P., as shown in Table XLIII., to 16,419,000 H.P. in 1924, an increase of almost exactly 6,000,000 H.P. Power

ORGANIZATION AND GROWTH OF THE HOME MARKET

plant used in electricity production rose from 2,300,000 H.P. in 1907 to 8,740,000 H.P. in 1924, an increase of 6,440,000 H.P., which is actually greater than that recorded for all prime movers. Electricity has not only accounted for the increase in power capacity, but it has actually encroached on other forms of power, and this process of conversion is becoming more rapid every year.

Steam turbines have been responsible for practically the entire increase in power plant, the decline in reciprocating engines being almost exactly balanced by the increase in internal combustion engines and, as Table XLIV. shows, steam turbines with 6,450,000 H.P. driving electric generators have been responsible for 96 per cent of all turbine installations.

The history of manufacturing equipment in this country is now almost entirely the history of electrical power extensions. Little attention may be devoted to power plants other than those referring to electricity while, even in discussing types of plant installed, steam turbines are alone at issue. A double revolution has been effected—a revolution caused by conversion to electricity as a first main source of power, and, second, a revolution in the nature of power-generating equipment itself, engines other than steam turbines having disappeared almost entirely from the generating stations. The revolution is entirely one of increased efficiency—efficiency in the form of energy produced and efficiency in the machinery employed to produce this energy.

The consequence has been that, over the period 1907–24, the industrial complex as a whole was reforming and improving its methods and was carrying out slowly but surely the formidable task of re-equipment. This work of conversion and modernizing must be regarded as a post-war development. The statistics prove this quite clearly. Thus the capacity of generating plant only increased by 1,000,000 kilowatts from 1907 to 1912 and, as far as we can judge, by 2,200,000 kilowatts from 1912 to 1920, during a period of feverish activity in connection with war requirements, when the Government actively encouraged the installation of power plant purely for munitions purposes, and, in a number of cases, assumed the burden of capital expenditure incurred. From 1920 to 1928, however, as Table XLV. indicates, 3,952,000 kilowatts were added. The figures given in Table XLV. have been based on statistics issued by the Electricity Commission and on information at our disposal regarding new plant supplied by the British manufacturers. It can be regarded, therefore, as fairly accurate. One check on this total of 3,952,000 kilowatts is provided by the statistics of new generating plant sanctioned by the Electricity Commission from January 1920 to March 1927. During this period 3,597,000 kilowatts were sanctioned, covering extension in new generating stations budgeted by local authorities, railway and tramway authorities, and non-statutory

MODERNIZATION AND ELECTRICAL MANUFACTURING

TABLE XLV—ELECTRICAL PLANT CAPACITY AND OUTPUT IN GREAT BRITAIN
(1920-1928)

Year.	Capacity of Generating Plant (Kilowatts).			Output of Electricity (Millions of Units).			
	Public Supply.*	Private Supply.	Total.	Public Supply.	Electric Railways and Tramways.	Private Industrial Plants.	Total.
1920	2,626,000	2,282,000	4,908,000	4734	433	3667	8,834
1921	2,986,000	2,374,000	5,360,000	4214	671	2669	7,554
1922	3,551,000	2,496,000	6,047,000	4883	856	3060	8,799
1923	3,678,000	2,507,000	6,185,000	5775	907	3280	9,952
1924	3,943,000	2,564,000	6,507,000	6454	961	3520	10,935
1925	4,415,000	2,675,000	7,090,000	7094	1029	3630	11,743
1926	4,883,000	2,802,000	7,685,000	7384	982	3400	11,766
1927	5,535,000	2,865,000	8,400,000	8829	1099	3900	13,828
1928	5,881,000	2,979,000	8,860,000	9750	1160	4050	14,960

* Based on 1924 Census and orders for generating plant.

undertakings. Private industrial plant was therefore responsible for the remaining 346,000 kilowatts. A closer analysis still shows that, from 1923 to 1928, the increase scheduled was actually 2,673,000 kilowatts, an increase in five years greater than that which took place between the twelve years 1912-24.

In the light of this information it is difficult to believe that this country has failed in the post-war decade to keep pace with modern developments and that its main necessity lies in extensions, the re-equipment of the basic industries, as well as a more thorough expansion of electrification in every national activity. The figures as shown would almost induce a feeling of national complacency; but this is dissipated when a comparison is made with other countries. In the United States, as Tables XLVI. and XLVII. show, it is possible for a country already greatly developed

TABLE XLVI—TOTAL CAPACITY AND OUTPUT OF PUBLIC SUPPLY
STATIONS IN U.S.A. (including Electric Railways)
(1912-1928)

Year.	Capacity of Generating Plant (Kilowatts).	Total Output of Electricity (Millions of Units).	Increase since 1912 (per cent).
1912	7,670,000	17,572	—
1922	15,971,000	47,654	170
1923	17,369,000	55,665	216
1924	19,519,000	59,014	235
1925	23,619,000	65,870	274
1926	25,398,000	73,791	319
1927	27,691,000	80,205	356
1928	30,300,000	87,859	399

[121]

ERRATUM

Page 121, line 3, "an increase, etc." should read "an annual rate of increase in five years almost twice that which took place during the period 1912-1924."

ORGANIZATION AND GROWTH OF THE HOME MARKET

TABLE XLVII—TOTAL GENERATING PLANT CAPACITY IN U.S.A.
(1914-1927)

Year.	Generating Plant Capacity (Kilowatts).			Total Production of Electricity (Millions of Units).
	Public Utilities.	Manufacturing Plants.	Total.	
1914	9,310,000	2,650,000	11,960,000	28,500
1919	13,619,000	4,700,000	18,319,000	55,400
1923	17,369,000	4,790,000	22,159,000	69,865
1925	23,619,000	5,500,000	29,119,000	82,170
1927	27,691,000	5,670,000	33,361,000	97,005

electrically to exceed the British rate of increase. Thus over the period 1912-28, public supply stations have quadrupled their capacity and quintupled their output, while in Great Britain, which admittedly was very far behind the United States in 1912, public supply undertakings also quadrupled their capacity during the same period, with, however, a much smaller expansion of output, production in 1928 being less than four times that of 1912. Private industrial plant increased in Great Britain by about 138 per cent, an average of about 7 per cent per annum, while the corresponding American increase was more than 8 per cent.

The statistics of generating plant alone do not tell the whole story. If they are brought into relation with the capacity of all motive power plant in the country, they show Britain in a much less favourable light. This has been done in Table XLVIII., where the Census figures have been brought up-to-date by the inclusion

TABLE XLVIII—TOTAL CAPACITY OF PRIMARY POWER PLANT IN GREAT BRITAIN
(1924-1928)

Year.	Capacity of all Prime Movers (Kilowatts).	Capacity of Electrical Generating Plant (Kilowatts).	Percentage of Generating Plant to Prime Movers.
1924	12,249,000	6,507,000	53.0
1925	13,040,000	7,090,000	54.0
1926	13,538,000	7,685,000	56.8
1927	14,328,000	8,400,000	58.6
1928	14,974,000	8,860,000	59.1

of new turbines manufactured, the assumption being that the decline in reciprocating engines may be counterbalanced by the increase in internal combustion engines as in previous years. At the end of 1927 electrical generating plant represented 58.6 per cent of all motive-power plant installed in Great Britain, inclusive of public

ANALYSIS OF MOTIVE-POWER PLANT IN BRITAIN

supply undertakings. The corresponding figure in the United States for the same year was 77 per cent. The annual rate of increase recorded in Great Britain was 1.4 per cent per annum, so that to reach the American degree of electrification Britain would require at least fourteen years at its present rate of development. It is evident that here Great Britain is many years behind the United States, and the remarkable effort made during a period of great depression has not been sufficient to make up the gap; the two countries are showing now a parallel rate of advance without any indication of a change in the position.

Table XLV. gives the output of electricity from 1920-28 for Great Britain. During this period output from public supply undertakings more than doubled and was accompanied by a similar movement in production by electric railway and tramway power plants. The private industrial plants, on the other hand, showed no increase between 1920 and 1927 and have only now moved beyond the 1920 figure, so that it has on the whole been operating on a much less satisfactory load factor than the public undertaking. As a result of this, conversion from private industrial to public supply has already been fairly rapid, but it will probably be more rapid as the public plants introduce more economic operation and cut down their costs to a level below which the private plant cannot compete. There is no doubt that for many types of industrial operation, especially in coal-mining, iron and steel, chemicals and textiles, the advantages accruing from the use of private installation, either through the opportunities it gives for utilizing waste heat or through the surplus steam it renders available for manufacturing processes, the public supply undertaking can scarcely hope to compete, and there will always be a definite percentage which cannot be reached by the public system. In the United States, as the table shows, even now the private manufacturing plant accounts for one-sixth of the total generating plant installed in the country. In Great Britain the proportion is one-third. A glance at Table XLII. shows that in 1924 the private plant was about 40 per cent, in 1912 46 per cent, and in 1907 slightly more than 41 per cent. This would prove that the conversion is a five years' development and has been hastened by the effect of trade depression in making the operation of the private plant uneconomic. A revival in trade would tend to slow down this process, but, judging by American standards, there is still room for a considerable movement of conversion.

The average annual rate of increase in generating plant in this country lies now between 550,000 and 650,000 kilowatts, while in the United States it is in excess of 2,500,000 kilowatts. In Germany, as Table XLIX. shows, the rate of increase lies between 750,000 and 850,000 kilowatts, so that both Germany and Great Britain

ORGANIZATION AND GROWTH OF THE HOME MARKET

TABLE XLIX—ELECTRICITY SUPPLY IN GERMANY
(1925-1928)

Year.	Capacity of Generating Plant (Kilowatts).			Output of Electricity (Millions of Units).		
	Public Supply.	Industry.	Total.	Public Supply.	Industry.	Total.
1925	4,463,161	4,250,000	8,713,161	9,914.7	10,413.3	20,328.0
1926	5,170,996	4,384,088	9,555,084	10,207.8	11,009.8	21,217.6
1927	5,727,946	4,514,587	10,242,533	12,316.5	12,818.0	25,134.5
1928*	6,430,000	4,654,000	11,084,000	14,100.0	14,000.8	28,100.8

* Estimated.

are still not in a position to adopt large-scale production methods, in the latter a result of the state of electrical demand in the home market. The total output in this country per head of population, including the commercial demand which would bring the figure for 1928 up to 15,600,000,000 units, is now 356 units, while in the United States it is about 840 and in Germany over 450. The difference between the German and British figures has been due to the greater industrial activity of the former and the very intensive degree of electrification resulting from developments since 1924. In a later section we give a direct international comparison showing the world position of Great Britain as far as industrial development and electrification are concerned.

The total capital invested in public supply undertakings in this country at the end of March 1927 was £238,728,000, equivalent to £51 per kilowatt of generating plant installed, generation alone accounting for £100,146,000, or £21.4 per kilowatt, transmission and distribution being therefore responsible for 58 per cent of the total expenditure. At the end of March 1921 the total capital invested was £143,716,000, the average capital expenditure being again £51 per kilowatt installed, generation alone accounting for £23.8. Transmission and distribution were responsible in 1922 for 54 per cent of the total capital expenditure, so that the process, which we have already indicated, whereby the demand for generating plant and power plant generally was yielding to a much more rapidly expanding demand for distribution equipment, is confirmed by these statistics. The total capital expenditure between the five years 1922 and 1927 was £95,000,000, an average of £19,000,000 per annum.

According to the Report of the Electricity Commission for the year ending March 1928, the total loans sanctioned by local authorities over eight years and one month from February 1920 to March 1928 amounted to £102,587,000. Of

INDUSTRIAL DEMAND FOR ELECTRICITY IN BRITAIN

this, expenditure on plant, mains, and services amount to £85,217,000, 1928 being the highest year with a total of £18,020,000. To this must be added expenditure by power supply companies, which can be given as in excess of £11,000,000, so that the annual capital investment is now actually in excess of £30,000,000 in the public supply of electricity.

III.—THE INDUSTRIAL DEMAND

Industry ranks second in importance to public supply from the point of view of power equipment. Even now, after the intensive development of domestic and commercial loads, industry still takes 64 per cent of the electricity sold by public undertakings, and the progress of power demand depends to a great extent on the rapidity with which manufacturing processes are converted to electric drive. As we have shown already, from the point of view of national electrification Britain has reached 59 per cent development, but in industrial electrification proper even this figure has not been reached. At a time when the American average is 78 per cent and the German 66 per cent, Britain fluctuates in the vicinity of 51 per cent. In Table L. we show comparative figures for Great Britain, Germany, and the United States. The total capacity of all electric motors in industry in 1912 in this country amounted to 2,241,000 H.P., 42 per cent of which was driven by purchased energy, and the degree of electrification in that year was 23 per cent. In 1924 the total was 7,942,000 H.P., of which 57.4 per cent was driven by purchased electricity, and the degree of electrification was about 51 per cent. For 1907 no reliable data is available. Table LI. shows that, in the United States, industry was electrified to the extent of 25 per cent in 1909 and of 78 per cent in 1927, but in that country conversion to the public supply undertaking has been even more rapid than in Great Britain, 36 per cent being driven by purchased energy in 1909 and 61 per cent in 1925.

In the pre-war years Britain had not fallen very far behind America as far as the use of electricity in industry was concerned, but the gap has widened enormously since that time; and it has widened as a result of the policy pursued by the public supply undertaking. America embarked early on a policy of large-scale development. It developed a system of load-building and carried out an extensive educative campaign with the results which we now see. It was assisted by the rapid industrial growth of the country as a whole, but through its enterprise it was able to gain a grip on this development and swing consumption over to the public supply systems. The result was acceleration of industrial electrification and, as a consequence, the

ORGANIZATION AND GROWTH OF THE HOME MARKET

TABLE L—INDUSTRIAL ELECTRIFICATION IN GT. BRITAIN, U.S.A., GERMANY

Industry.	Total Capacity of Primary Motive Power (H.P.).			Total Capacity of Electric Motors (H.P.).			Degree of Electrification (per cent).		
	Great Britain, 1924.	U.S.A., 1925.	Germany, 1925.	Great Britain, 1924.	U.S.A., 1925.	Germany, 1925.	Great Britain, 1924.	U.S.A., 1925.	Germany, 1925.
Coal-mining and coke-production	4,016,627	—	2,749,191	1,642,928	—	1,296,686	41	—	47
Blast furnaces	474,232	1,939,000	1,044,015	139,630	385,747	736,920	29	20	71
Steel works and rolling mills	1,830,863	4,763,633	2,282,286	921,215	3,758,167	1,727,346	50	79	76
All iron and steel	2,599,874	7,518,999	3,451,943	1,096,115	5,389,820	2,541,112	42	72	74
All engineering	1,120,907	2,714,377	1,375,019	1,013,203	2,822,977	1,277,908	91	100	93
Automobiles	194,157	1,172,013	143,452	171,696	517,920	131,075	88	44	92
Electrical machinery	157,225	589,398	377,884	158,170	1,688,430	370,429	100	100	98
Shipbuilding	538,619	303,470	274,589	498,415	286,197	225,831	93	95	82
Railway carriages and waggons, etc.	64,858	291,400	93,944	62,506	—	88,323	97	—	94
Railway workshops	—	942,248	6,179	—	775,553	5,629	—	82	91
Hardware (N.E.S.)	57,760	98,278	75,666	40,964	78,621	65,915	71	80	87
Non-ferrous metals	218,690	361,242	411,756	145,269	1413,054	357,472	67	100	87
Cotton	1,575,644	2,236,363	560,994	305,465	1,463,454	270,674	19	66	49
Wool	149,737	570,295	271,801	142,120	364,575	145,276	95	64	54
Hosiery	29,691	176,630	46,688	16,674	—	36,671	56	—	79
Silk	53,681	212,609	61,308	32,123	156,108	59,083	60	74	97
Jute, hemp, etc.	104,094	—	121,043	28,411	19,805	51,784	27	—	43
Rope, twine, and net	53,681	—	23,536	14,281	49,214	10,953	72	—	47
Hat, bonnet, etc.	12,399	—	14,609	9,668	—	9,835	78	—	78
Clothing	38,270	69,065	19,039	29,983	60,631	16,616	78	88	87
Dyeing and finishing	266,483	252,701	103,480	140,992	196,587	68,899	53	78	67
All textiles	—	3,986,136	1,279,068	—	2,691,285	706,257	—	67	55
Paper and pulp	280,859	2,427,010	799,617	152,425	1,309,517	442,593	54	54	55
Printing and bookbinding	100,510	169,293	103,351	75,514	162,270	98,243	75	96	95
Newspapers, etc.	65,980	237,662	66,752	56,337	227,808	64,168	86	96	96
All paper	450,943	3,060,794	977,215	287,288	1,903,643	610,855	63	62	63
Chemicals	228,761	2,984,913	948,413	118,098	1,891,982	684,051	52	63	72
Boots and shoes	62,663	139,569	57,151	35,920	112,901	49,434	57	81	86
Leather, tanning, etc.	74,283	222,678	125,167	45,677	169,576	97,457	62	76	78
Bakery products	80,309	227,286	146,763	66,103	216,862	141,619	82	96	97
Canning, etc.	—	187,490	15,932	—	104,823	11,986	—	56	75
Confectionery	56,401	100,455	89,064	53,866	97,437	76,423	96	97	86
Butter, cheese, etc.	28,095	201,639	151,054	18,504	—	87,430	66	—	58
Sugar-refining	38,860	89,098	100,139	33,883	1165,600	55,701	87	100	56
All food	—	3,881,592	1,706,946	—	2,565,263	965,610	—	66	57
Flour mills, etc.	198,195	669,900	612,845	68,521	345,387	168,721	35	57	28
Seed-crushing	77,021	239,005	46,775	40,964	100,073	28,648	53	42	61
Brick and clay products	163,509	517,204	284,677	42,106	288,246	106,471	26	56	37
Glass and building materials	88,984	*271,639	71,570	78,120	*159,167	56,169	88	59	78
All stone, clay, and glass products	—	2,348,157	900,955	—	1,893,442	511,977	—	81	57
Brewing and malting	104,209	15,259	197,117	65,277	12,352	120,248	63	81	61
Building and contracting	190,979	—	442,059	97,474	—	216,747	51	—	49
Furniture	50,525	402,519	365,422	34,256	320,140	291,562	68	80	80
Planing mill products	174,393	597,103	367,721	86,339	399,922	103,613	50	67	28
Lumber and timber products	—	2,049,500	—	—	740,257	—	—	36	—
All timber and wood-working	—	3,472,770	1,022,470	—	1,708,799	600,368	—	49	59
Rubber	106,196	656,857	92,680	92,985	618,702	76,629	88	94	83
Tobacco	16,498	42,075	24,463	11,765	31,631	22,123	71	75	90
Wooden boxes, etc.	25,456	148,729	33,533	14,115	80,981	15,803	55	54	47
All industries	15,494,000	35,772,628	17,656,660	7,942,000	26,123,573	11,625,303	51	73	67

* Glass only for U.S.A.

† Owing to high diversity factor, the capacity of electric motors may exceed that of all primary power.

DEMAND IN GREAT BRITAIN, U.S.A., AND GERMANY

TABLE LI—AMOUNT OF TOTAL FACTORY POWER IN AMERICA APPLIED
THROUGH ELECTRIC MOTORS (H.P.)
(1899-1927)

Year ending Dec. 31.	Total Primary Power.*	Total Horse-power in Electric Motors.	Operated by Energy Generated in Plant.	Operated by Energy from Central Stations.	Per cent Electrified.†
1899	10,097,893	492,936	310,374	182,562	5
1904	13,487,707	1,592,475	1,150,886	441,589	12
1909	18,675,376	4,817,140	3,068,109	1,749,031	25
1914	22,290,899	8,823,254	4,938,530	3,884,724	39
1919	29,327,669	16,253,702	6,969,203	9,284,499	55
1923	33,094,228	22,151,997	8,819,217	13,332,780	66
1925	35,772,628	26,123,573	10,254,745	15,868,828	73
1927 §	39,040,563	30,360,026	11,216,282	19,143,744 ‡	78

* From 1914 onwards, this table eliminates all establishments reporting products under \$5000 in value. In addition, items covering establishments engaged in automobile repairing have been omitted.

† Primary horse-power embraces prime movers driving industrial motors; these prime movers are about 89.5 per cent of the capacity of the motors connected to them, not all of which are ever in operation at any one time. For this last column the horse-power of motors operated by energy generated in the plant itself has been scaled down accordingly.

‡ Operated by energy from purchased current.

§ Figures for 1927 are preliminary.

realization of a high level of efficiency in industry generally. In this country no such enterprise obtained, with the exception of a few undertakings, and industrial electrification, which was artificially propagated during the war for purposes of war production, has been allowed to evolve by a natural process without stimulation or encouragement. To this, as much as to trade depression, must be attributed the low standard of electrification ruling in this country.

Germany presents a similar development. In 1907 19.5 per cent of all manufacturing machinery was driven by electric motors, and in 1925 66 per cent. No information is available regarding the effect of enterprise by the public supply undertaking on industrial demand, but, in view of the fact that 55 per cent of all generating plant in the country is represented by private industrial installations, one can assume that the industrial executive itself was early convinced of the importance of electrification and acted accordingly without the necessity of special co-operation on the part of the supply undertaking. The great work of rationalization carried out in Germany since 1924 has not only created a large demand for electrical plant and equipment but it has, through the influence of such large contracts and quantity production on the part of the electrical manufacturers, improved their competitive efficiency and allowed them to carry out a dumping policy on a Reparations delivery basis with comparative ease.

ORGANIZATION AND GROWTH OF THE HOME MARKET

In Great Britain this has not been the case. Even although the large industries have not fallen absolutely behind German or American and are in a stronger position than the critics have allowed them, they have not embarked on fundamental schemes of reconstruction and have not laid down new manufacturing equipment conceived on purely modern lines. They have contented themselves with improvement of existing equipment where such improvement could be carried out without heavy capital expenditure, and the decline which has taken place in their profit-earning capacity has rendered almost impossible the realization of new capital necessary for large rationalization schemes.

The industrial demand both for electricity and electrical equipment has been subnormal for eight years, but the progress of amalgamations, especially in iron and steel, would indicate that this period of comparative inertia is past, and that, granted sufficient encouragement, the leading British industries have now before them a period of reorganization which will be accompanied by a rapid upward swing in the power consumption curve. This should allow the electrical undertakings to operate at a much more satisfactory load factor and to reduce their costs to a point where electrification will be accelerated. The initiation of the national power scheme, and the virtual obligation imposed on the Central Electricity Board to make this scheme a success, will do much to instil a spirit of enterprise into public undertakings and make them more ready to adopt sound methods of load-building.

To show the real deficiency that exists in industrial electrification, we have made, in Table LII., a calculation based on comparisons with Germany of the additional capacity of electric motors which will be required to bring British industry, first of all, up to the German standard, and, secondly, up to what might be regarded as an optimum standard of electrical development with the existing productive capacity. In a number of industries, such as paper, grain-milling, chemicals, cotton and textiles generally, special manufacturing requirements may render impossible complete electrification. In these industries there is a considerable demand for process steam, and it may be more economical to use steam in direct mechanical drive for a number of manufacturing processes where the cost situation would justify it. In the table allowance has been made for this. A number of industries, again, may be seriously under-equipped and require a very considerable extension of mechanical and electrical power plant before they can be genuinely efficient. This observation applies to the textile trades, to boot and shoe manufacture, paint and varnish, tobacco, and a number of very small industries which are not included in the total. Coal-mining may conceivably also come under this category.

DEFICIENCY IN INDUSTRIAL ELECTRIFICATION

TABLE LII—DEFICIENCY OF ELECTRIC MOTORS IN BRITISH INDUSTRY

Industry.	Total Capacity of Electric Motors (H.P.).				
	1. Actual.	2. Raised to per cent of Electrification obtaining in Germany.	3. Raised to Estimated Maximum.	4. Deficit on (2).	5. Deficit on (3).
Coal-mining, etc.	1,642,928	1,880,000	(75) 3,050,000	237,072	1,407,072
Iron and steel, etc.	1,096,115	1,930,000	(80) 2,070,000	833,885	973,885
Shipbuilding	498,415	498,415	(100) 539,000.	—	40,585
Railway carriages and waggons	62,506	62,506	(98) 64,000	—	1,494
Motors and cycles	171,696	180,000	(98) 190,000	8,304	18,304
Cement	69,759	69,759	(80) 89,500	—	19,741
Cotton	305,465	790,000	(65) 945,000	484,535	639,535
Hosiery trades	16,674	23,500	(95) 28,200	6,826	11,526
Jute, hemp, and linen trades	28,411	45,000	(65) 67,600	16,589	39,189
Silk and artificial silk	32,123	52,000	(95) 52,000	9,877	19,877
Rope, twine, and net trades	14,281	14,281	(95) 18,700	—	4,419
Linoleum and oil-cloth	21,079	26,300	(95) 41,000	5,221	18,921
Paper trade	152,425	155,000	(65) 187,000	2,575	34,575
Printing and bookbinding	75,514	95,700	(98) 103,000	20,186	27,486
Newspapers	56,337	63,000	(98) 64,500	6,663	8,163
Boots and shoes	35,920	54,000	(98) 61,500	18,080	25,580
Grain-milling	68,521	68,521	(60) 119,000	—	50,479
Seed-crushing	40,964	47,000	(65) 50,000	6,036	9,036
Sugar and glucose	33,883	33,883	(98) 38,000	—	4,117
Soap and candles	19,965	36,200	(98) 43,500	16,235	23,535
Rubber	92,985	92,985	(98) 104,000	—	11,015
Paint and varnish	26,431	32,000	(98) 36,700	5,569	10,269
Tobacco	11,765	14,900	(98) 16,200	2,135	4,535
Total	4,576,162	6,264,950	(77) 7,978,400	1,688,788	3,402,238
Total of all industries	7,942,000	10,450,000	(77) 12,000,000	2,508,000	4,058,000

In a later section we attempt to establish what might be regarded as an optimum industrialization figure for the whole country based on comparisons with America, Germany, and other countries. In Table LII. no allowance whatever is made for this, with the result that the figures shown here represent a minimum. To reach the German level of industrial electrification 2,500,000 H.P. are required; the industries showing the greatest deficits being iron and steel with 834,000 H.P., represented largely by the retention of reciprocating engines for rolling-mill drive instead of electric motors; cotton, with a deficit of 485,000 H.P., resulting from the predominance of the small undertaking with limited capital resources in that industry; and coal-mining, with a deficit of 237,000 H.P. Since the publication of the 1924 Census, colliery electrification statistics bearing on 1928 can be deduced

ORGANIZATION AND GROWTH OF THE HOME MARKET

from the last annual report of H.M. Inspector of Mines. According to it, there has been an increase of more than 200,000 H.P. of electric motors installed in British coal-mining, so that if the 1925 figures still apply to Germany the deficit shown in the table has been made good. The two main industries, therefore, in which the greatest development should be expected are iron and steel and cotton.

The leeway to be made good before an optimum condition will be reached has been estimated at 4,058,000 H.P., and of this total coal-mining is first with 1,400,000 H.P. or, if the advance since 1924 is considered, 1,200,000 H.P. ; iron and steel second with 974,000 H.P. ; and textiles third with 640,000 H.P. The only other industries of importance from the point of view of potential electrification are chemicals, grain-milling, shipbuilding, and other sections of the textile industries. It is evident from this examination that the main effort should be concentrated on three industries at most and that the British electrical manufacturer should expect from them the most important expansion of industrial demand. A similar observation applies to electricity supply undertakings. The industrial demand, therefore, is bound up with the reorganizing activities of the coal-mining, iron and steel, and textile industries, and electrical manufacture must be directly interested in any scheme which will restore prosperity to them.

IV.—INTERNATIONAL POWER SURVEY

To obtain some international perspective bearing on this question of industrial development as it affects countries as a whole, we have carried out in a series of tables from LIII. to LIX. onwards an investigation bearing on ten industrial countries, including some of the most important competitors of Great Britain. The result of this investigation is given below :

As a result of information which has been rendered available during the last two years, it is now possible to make some international comparison and thus establish some fundamental principles. One can distinguish perhaps four factors governing economic development in the modern industrial state :

- (1) Natural resources, which can be used for industrial production purposes, and the extent to which they are developed ;
- (2) The degree of industrialization as measured by the capacity of prime-movers and the power production per unit of output ;
- (3) The alignment of industries within this manufacturing complex ;
- (4) The state of electrification and electrical power consumption.

The order of importance is exactly that given. It is dangerous to isolate the fourth factor from the remaining three and try to establish an economic theory based on it, even although certain matters of detail may be of interest in a general investigation covering industrial output. All four factors com-

INTERNATIONAL POWER SURVEY—PLANT CAPACITY

bined decide the industrial significance or otherwise of any country, and they govern the balance of economic power considered internationally.

Thus, to take each factor in turn, a country may be rich in natural resources, such as water power, coal, iron ore, potash, and other mining products, and yet be unable to use them properly, owing to the fact that it has not been able to develop its manufacturing machinery effectively, has not been able to attract to it sufficient population to make machinery effective and to constitute a national basis of demand, or it has been unable to employ sufficient capital to carry on development. On the other hand, a country with limited natural resources may be able to carry out specialization in the resources it possesses

TABLE LIII—PRIME-MOVER CAPACITY
(H.P.)

Country.	Year.	Steam Power Plant.	Water Power Plant.	Internal Combustion, etc.	Total.
Great Britain . . .	1924	15,019,000	204,000	1,196,000	16,419,000
U.S.A.	1927	45,376,000	10,520,000	1,659,000	57,555,000
Germany	1925	17,757,000	2,038,000	2,020,000	21,815,000
France	1926	7,400,000	2,800,000	607,000	10,870,000
Italy	1927	3,374,000*	5,000,000	—	8,374,000
Canada	1925	993,000	4,013,000	77,000	5,083,000
Switzerland . . .	1923	124,000	1,199,000	16,000	1,686,000†
Holland	1926	1,066,000	24,000	—	1,090,000
Poland	1925	1,568,000	—	88,000	1,656,000
Japan	1926	2,007,000	2,308,000	55,000	4,370,000
Total		94,684,000	28,106,000	5,718,000	128,918,000

* Including internal combustion engines, etc.

† Including power purchased.

TABLE LIV—ELECTRICAL POWER PLANT CAPACITY
(H.P.)

Country.	Year.	Public Supply.	Private Supply.	Total.	Percentage of Prime-Mover Capacity.
Great Britain . . .	1924	5,382,000	3,419,000	8,701,000	53
U.S.A.	1927	36,900,000	7,560,000	44,460,000	77
Germany	1925	5,950,000	7,350,000	13,300,000	63
France	1926	6,123,000	3,047,000	9,170,000	85
Italy	1927	4,190,000	540,000	4,730,000	57
Canada	1926	3,685,000	871,000	4,556,000	90
Switzerland . . .	1927	—	—	2,138,000	85
Holland	1926	834,000	—	834,000	76
Poland	1925	662,000	395,000	1,057,000	64
Japan	1926	3,472,000	798,000	4,270,000	95
Total		67,198,000*	23,980,000*	93,216,000	72

* Switzerland omitted.

ORGANIZATION AND GROWTH OF THE HOME MARKET

TABLE LV—ELECTRIC MOTORS INSTALLED IN INDUSTRY (H.P.)

Country.	Year.	Total of all Electric Motors.	Total of all Primary Power + Motors driven by Purchased Energy.	Degree of Electrification (per cent).
Great Britain	1924	7,942,000	15,494,000	51
U.S.A.	1927	29,084,000	39,239,000	75
Germany	1925	11,625,000	17,657,000	66
Canada	1925	1,983,000	2,946,000	67
Holland	1926	315,000	571,000	55
Poland	1925	267,000	994,000	27
Japan	1926	2,293,000	2,593,000	88
Total		53,509,000	79,494,000	67

TABLE LVI—PRODUCTION OF ELECTRICITY FROM ALL SOURCES

Country.	Year.	Total Capacity of all Generating Plant (Kilowatts).	Total Output of Electricity (Units).
Great Britain	1927	8,458,000	15,600,000,000
U.S.A.	1927	33,361,000	97,000,000,000
Germany	1927	10,243,000	25,134,500,000
France	1927	7,770,000	13,000,000,000
Italy	1927	3,545,000	9,150,000,000
Canada	1926	3,420,000	15,000,000,000
Switzerland	1927	1,600,000	4,593,000,000
Holland	1927	690,684	1,323,000,000
Japan	1927	5,384,290	10,558,800,000
Poland	1926	1,000,000	2,100,000,000
Total		75,471,974	193,459,300,000

TABLE LVII—INDUSTRIAL AND ELECTRICAL DEVELOPMENT

Country.	Population (Millions).	Prime-Mover Capacity per Head of Population (H.P.).	Index U.S.A. = 100.	Electrical Power Production per Head of Population (Units).	Index U.S.A. = 100.
Great Britain	44.0	0.374	75	356	42.2
U.S.A.	115.0	0.500	100	844	100.0
Germany	62.5	0.350	70	402	47.6
France	40.0	0.272	54	325	38.5
Italy	38.7	0.216	43	236	27.9
Canada	9.4	0.540	108	1600	185.0
Switzerland	3.9	0.434	87	1175	139.0
Holland	7.4	0.147	29	179	21.2
Japan	59.7	0.073	15	180	21.3
Poland	27.2	0.061	12	77	9.1
Total	407.8	0.317	63	475	56.3

OPTIMUM INDUSTRIAL AND ELECTRICAL DEVELOPMENT

TABLE LVIII—OPTIMUM ELECTRICAL DEVELOPMENT

(Based on degree of Industrialization and American Averages)

(Units)

Country.	Electrical Power Production per Head of Population * (Net).	Optimum Electrical Power Production per Head of Population.	Deficit on Existing Output.	
			Per Head of Population.	Total Output.
Great Britain	356	630	274	12,100,000,000
U.S.A.	844	844	—	—
Germany	402	590	188	11,700,000,000
France	260	454	194	7,760,000,000
Italy	236	360	124	6,800,000,000
Canada	1429	—	—	—
Switzerland	705	730	25	97,000,000
Holland	179	244	65	481,000,000
Japan	180	—	—	—
Poland	77	101	24	650,000,000

* Eliminating exported energy and energy used purely for electro-chemical and electro-metallurgical purposes.

TABLE LIX—OPTIMUM ELECTRICAL PRODUCTION

(Based on degree of Industrialization and American Averages)

Country.	Output (Units).	Percentage of Existing Output.
Great Britain	27,700,000,000	178
U.S.A.	97,000,000,000	100
Germany	36,834,000,000	146
France	20,760,000,000	160
Italy	13,950,000,000	153
Canada	15,000,000,000	100
Switzerland	4,690,000,000	102
Holland	1,804,000,000	136
Japan	10,550,800,000	100
Poland	2,750,000,000	131
Total	231,038,800,000	120

by a diversion of industrial production, and so obtain an economic result as favourable as that secured by another country with greater resources. The ideal, of course, is reached when a country with abundant natural resources, like the United States, is able to use them with the greatest facility and increase indefinitely the national wealth directly available. One could not compare, from the power point of view, countries in which these differences existed, and some allowance must be made at the outset for natural conditions.

In the second place, the technical history of a country may have had considerable influence on prime-mover capacity. An old industrial country like Great Britain has accumulated over its long period

ORGANIZATION AND GROWTH OF THE HOME MARKET

of industrial production, equipment and methods which are traditional and have been proved to be inefficient under modern conditions, and yet represent a capital investment which has not yet been written off. Conversion to more modern types of equipment means at once very heavy depreciation and the raising of new capital with little immediate prospect of increased output to justify such capital expenditure. The internal financial resources of industry may prove inadequate to such a change, and its resources become exhausted as competition from new countries, without this difficulty, increases.

In other countries, such as the United States, with no long-dated industrial tradition behind them, the equipment of industry has been carried out on the most modern system available at the time, with the result that the plant in it may have a much higher percentage of absolutely modern type than in Britain. In this case there is no necessity for heavy depreciation, there is no capital loss in prospect, and industrial production is carried out on a very low capital cost basis per unit of equipment.

In other countries again, where political developments have intervened, notably France, Belgium, and Germany, conditions may be favourable to the introduction of modern equipment at low capital cost. Thus, in France, the reconstruction of the devastated territories has meant the reconditioning and re-equipment of the entire industrial complex operating in the north of France and, above all, of the coal-mining and textile industries. France has also benefited from the German policy carried out in Lorraine, which was developed intensively from 1870 onwards, and in this connection has also the benefit of recent practice coupled with the installation of plant of high productive capacity. Germany, for political reasons, has been particularly favoured in this work of reconditioning and re-equipment of modern industry, owing to the set determination of the German Government to make the country industrially superior to any other country in Europe and render possible a vast movement of economic expansion.

These considerations are mentioned merely to show that prime-mover capacity is not in itself significant of the state of industrial development. One country may have modern equipment and another country old equipment, the former deriving a much higher output at a lower cost from the same power capacity.

The third factor, which is dependent on the first and second, lies of course in the type of industry which has been established. Thus a country with very large natural resources will develop raw-material industries which require a very heavy plant capacity per ton of output. Among these industries may be mentioned coal-mining, iron and steel, shipbuilding, general engineering, and chemicals. With industries of this type, the power equipment must be very heavy, taken as a national aggregate, while the value of production, measured in monetary values alone, may not be as high as in the finishing industries, where their products serve as raw materials.

Thus the United States, Germany, Great Britain, France, and Belgium can show a very large prime-mover capacity located in these industries, and their preponderance has brought the national total up to a very high figure. Other countries without these resources, or, perhaps, in addition to these resources, have concentrated on industries where labour and the quality of workmanship decide industrial value. This observation applies to textiles, motor-car manufacture, fine paper production, and finished iron and steel, engineering and electrical manufacture. By concentration on industries of this kind, industrialization may be more intense in countries like Switzerland and the north of Italy, for example, than in metallurgical countries.

A further stage, which is dependent on electrification, can be found in the expansion of a whole group of industries depending entirely on power, notably water power. These industries cover paper, electro-chemistry and electro-metallurgy, and intensive agricultural development based on irrigation

MAIN ASPECTS OF INTERNATIONAL DEVELOPMENT

and land reclamation. These industries have caused a change in the economic alignment of Europe. They have given new prominence to France, Switzerland, Italy, Austria, Southern Germany, Spain, Norway, and Sweden, and brought them up to a higher level of development than might have been expected a few decades ago.

The fourth factor, which has come last of all, has been electrification. The economic significance of electricity has lain, above all, in the possibilities it affords of mass production and long-distance transmission of power, so that natural resources can be tapped easily, developed economically, and rendered available for national economic purposes. In addition to this, electricity lends itself to centralized production and, through the realization of this central production, to very great economies in operating costs per unit, so that, if rationally employed, it becomes definitely cheaper than any other form of power.

Electrical machinery, in turn, is more economical from the point of view of reliable and safe operation and elasticity of application than any other form of power. It lends itself easily to repetition work, to automatic control, and is essential to production in series or mass production generally in industry. In other words, prime-mover capacity, as reflected in the use of electrical plant, has become a sure indication of the state of modernization of industrial equipment, and electrification, therefore, gives us some basis of assessment in connection with the prime-mover capacity of industry.

Electricity, again, through the fact that it has rendered available for industrial activity water power resources which hitherto were valueless, has rendered possible the industrialization of new countries, and brought agricultural countries to a much higher level of industrialization. It has tended to level out, to some extent, economic differences ruling between countries, especially in Europe, and is a factor making for world economic expansion on a broad and rational basis.

In the light of these considerations, we may survey the power situation in a number of countries, for which reliable statistics are available.

The seven statistical tables (pages 131-133) represent seven stages in the exact appreciation of the state of electrical development and of the optimum output which may be expected from the state of industrialization of the ten countries under consideration.

In the first stage, which deals purely with prime-mover capacity, a distinction has been made between steam power plant, water power plant, internal combustion, and gas engines. In each case the capacity of public electricity supply undertakings has been added to the total to show the effective primary motive power at the disposal of the countries in question. In Great Britain, U.S.A., Germany, Italy, Canada, Switzerland, Poland, and Japan the statistics are as given in official surveys. In France, Holland, and Poland, there is reason to believe that a number of industries has been omitted, with the effect that the final figure is slightly lower than might be expected. The table, as it stands, is sufficiently accurate, however, to give a picture of prime-mover development in the leading industrial countries. The exceptions of importance are, of course, Central Europe as a whole, Scandinavia, and Russia. One may assume with a fair degree of accuracy that the figures given represent at least 80 per cent of the motive power capacity of the world.

Two points of special interest in this table are to be found in the high degree of water power development in the U.S.A. and Canada and Italy, and the preference shown by Germany for gas engines. The United States alone accounts for over 40 per cent of the total recorded for all ten countries.

The second table deals with electrical power plant alone, and a distinction is made between public supply and private supply, the latter being composed largely of private industrial plants which are not attached to any public system. French statistics do not make the line of demarcation very clear, with the

ORGANIZATION AND GROWTH OF THE HOME MARKET

result that there may be still a high percentage of public supply in their private plant figures, or vice versa. The resultant total gives, however, a fairly clear picture. The Italian statistics have been based on certain calculations made by the Italian Association of Electricity Supply Undertakings, while the Dutch figures may be regarded as applying to all undertakings, since they include mining power stations and one iron and steel station, both attached to public supply networks.

If those aggregates are taken as a percentage of the total prime-mover capacity, as recorded in Table LVI., a first approach is made towards a definition of the state of electrification. In this case it is surprising to find how high a percentage France, Canada, Switzerland, and Japan represent. This may be due, in the case of France, Canada, and Japan, to the fact that industrial development in these countries has been comparatively new, and has taken the form of electrification. In Canada and Switzerland water power resources have decided industrial expansion and the particular types of industry in which these countries have specialized—in Canada, paper and electro-metallurgy; in Switzerland, electro-chemistry, electro-metallurgy, and electric traction.

The Italian figure is low, due in all probability to the fact that practically the entire output of the country has been devoted to power purposes, as apart from lighting and domestic. A similar observation applies to Germany. It is significant, however, that Britain should show the lowest figure of all, and this must be attributed to the retention of prime-mover plant which is not used to drive electric generators.

A proviso of some importance should be made, however, to the effect that, outside of the large industrial countries such as Great Britain, U.S.A., Germany, and Italy, electrical development has not yet reached the stage where uniform expansion over all types of demand, from lighting and domestic to industrial power, has taken place, so that in Poland and Holland and, to some extent, France, for example, a high percentage of the generating plant shown is not applied to industry at all.

In the third table of the series an effort has been made to limit the issues purely to industry, as far as reliable statistics could be discovered. For Italy, Switzerland, and France no census figures have been available, but one can assume that in Italy and Switzerland at least a much higher degree of electrification even than in Germany or America would be recorded, owing to the entire dependence of those countries on water power plants. The total of all primary power does not include electricity supply, so that the aggregate here given is that of motors and engines driving machines and other equipment direct.

In this case again the British figure is, with the exception of Poland, the lowest in the scale, while the Japanese and American figures are the highest. Germany and Canada show about the same percentage—the German average, namely 66 per cent, being 30 per cent higher than that recorded for Great Britain.

The fourth stage is covered by the assessment of the production of electricity from all sources for the ten countries mentioned, the grand total being 193,000,000,000 units for the year 1927. On this basis the world total from all sources would lie between 230,000,000,000 and 250,000,000,000 units, while the total capacity of all generating plant would lie between 90,000,000 KW. and 95,000,000 KW.

A further stage has lain in the co-ordination of prime-mover capacity and electrical power production per head of population. If one assumes that over 80 per cent of electrical power consumption, direct and indirect, goes into manufacturing operations of some kind, motive power capacity in industry should make it possible to draw a broad distinction between countries where a very high power production per head of population may be expected and other countries where a much lower level of development should take place.

In one case, namely Switzerland, the figures shown are for 1927. The most highly industrialized

TOTAL PRIME-MOVER CAPACITY AND ELECTRIFICATION

country is Canada, followed by the United States, Switzerland, Great Britain, Germany, France, and Italy. One must, however, make some modification in these figures. The Canadian figures are abnormally high, owing to the predominance of one great power-consuming industry—namely, paper and pulp production—combined with the export of 1,600,000,000 units of energy to the United States annually. If allowance is made for these factors, the Canadian figure is about the same as that of Great Britain. In Switzerland electro-chemistry and electro-metallurgy and the export of 960,000,000 units annually have made the figure abnormally high, and, in this case again, elimination of these industries or sources of demand would probably reduce the Swiss figure to that of France. In Holland, Japan, and Poland, all three predominantly agricultural countries, industrial development is not yet far advanced, with the result that a high percentage of electrical power production goes into lighting and domestic, agricultural, electric railway, and traction supplies. These considerations are of importance when the electrical power production per head of population is considered.

In the sixth table an effort is made to eliminate a number of those factors, while what may be regarded as an optimum electrical power output, based on American results, has been established for each country. In Canada and Japan the optimum output has already been exceeded with the present state of industrialization, but in Japan this does not necessarily mean that all the power potentialities of the country are exhausted at the present time; it simply shows that the industrial expansion of Japan has already been based on electrical power, and that a further development in this direction must bring with it a corresponding increase in electrical power consumption. This observation applies also to Poland and Holland.

In the final table the total optimum output based on the degree of industrialization and American averages has been established for all ten countries. Great Britain has still the greatest leeway to make up. Her existing output would require to be increased 78 per cent to come up to the level of the United States. In a further section of the chapter we analyse more closely the nature of the potential demand and reach a slightly higher figure than that given in Table LIX. France comes next with 60 per cent, Italy with 53 per cent, Germany with 46 per cent, Holland with 36 per cent, and Poland with 31 per cent. Canada and Switzerland have reached the American level. These statistics may be taken as on the low side in each case, owing to the fact that no attempt has been made to assess the effect of progress in the lighting and domestic sphere on electrical power production in Great Britain, Germany, France, Italy, Japan, Poland, and Holland, where the rate of progress is definitely inferior to that of the United States. Similarly no attempt has been made to calculate the effect of railway electrification and the establishment of new industries on electrical power production. One would assume, therefore, that, without exception, these figures will be exceeded, even if a great part of the leeway already existing has been due to lack of electrification taken as a national economic development. From these calculations one would assume that the world optimum output is more than 300,000,000,000 units, compared with a present total of 240,000,000,000 units.

V.—THE POTENTIAL POWER MARKET

The final stage in this investigation regarding the home market lies in the definition of what may be regarded as the limits of expansion before a period of stability will have been reached. As we have already indicated at certain points, four main factors exert a decisive influence on the expansion of electricity and

ORGANIZATION AND GROWTH OF THE HOME MARKET

influence the methods of calculating the maximum development which might be expected in the near future. These four factors are :

(1) *Economic*.—In view of the fact that every economic activity in the modern state touches at one point or another on electricity, general movements affecting the prosperity of the whole country have a bearing also on electricity supply. Thus, if industry becomes seriously depressed or passes through a severe industrial crisis, consumption goes down, and again, if financial conditions are not entirely favourable to the expansion of production, then a brake is laid very soon on important projects devoted to the re-equipment and expansion of the manufacturing capacity of industry, which retards also the growth of power demand. Again, fiscal policy may well exert an influence. Thus the protection of agriculture and the granting of special subsidies to various industries may well serve to open up a market which has hitherto been closed, while an improvement in the standard of living may be translated into greater demand for electrical appliances for domestic purposes. It is impossible, therefore, to ignore purely economic factors in discussing developments in the electricity supply industry.

(2) *Price Conditions*.—Under a regime of falling prices there may be stimulation of consumption, which continues as wider areas of potential demand are tapped, but, on the other hand, they may lead to interruption of the rate of expansion, owing to the general feeling that prices will fall still further. The price cycle affects electricity as much as any other commodity, and there is undoubtedly a point where consumption may be stimulated to a maximum through the realization of the economic price standard. When that price standard has been reached, then something like stability intervenes in the industry.

(3) *Technical*.—Technical developments may have a lasting significance as, for example, the steady improvement in annual load factor caused by interconnection and the concentration of power production in large generating stations. Such an improvement in load factor serves to reduce the demand for new plant, and it may also lead to such economies in production that an economic price level can be reached within a shorter period than would otherwise be the case. Against this may be placed the fact that, as the range of consumption widens out to cover more national activities, the load factor becomes steadily worse. Thus, a supply undertaking which is forced to concentrate on the domestic or smaller commercial demand has not such a good load factor as an undertaking supplying exclusively several large industrial firms. This consideration applies especially to the electrification of rural areas and of agriculture. On the one hand, therefore, there is an improvement effected in load factor through technical developments, but such an improvement may tend to be neutralized by the changing nature of demand itself.

(4) *Competition*.—If it can be assumed that electrical power, under present conditions of production, will always form the principal motive force employed in industry and in other activities, then the validity of calculations made is so much greater; but the growth of invention may well substitute some other form of power for electricity, with the result that the future may be a repetition of the process of conversion from electricity to this new form of power in much the same way as direct mechanical power has been converted to electricity. Any estimate made of future growth must always bear this proviso.

Quite apart from these considerations, the question of material arises. Is there sufficient material on which estimates of growth can be based, or are there sufficient limiting factors present to guide estimates and prevent them from becoming fantas-

DISTRIBUTION OF CONSUMPTION IN GREAT BRITAIN

tically inaccurate? In the case of electricity supply, the material is almost sufficient. Thus we have the total national output of electricity by authorized undertakers since 1920; the total generating plant capacity; the distribution of power consumption among the various types of consumer—industrial, domestic, traction, etc.; the capacity of electric motors installed in industry and the demand for electricity based on such capacity; and the output of electricity per horse-power of electric motors installed in industry in a large number of industrial areas. In addition to this, we have full information regarding the United States and Germany, both countries highly developed electrically, which may serve as a check on calculations devoted to British conditions exclusively.

If, having regard to the four factors already discussed, we examine the statistics at our disposal, we may be able to develop what is a logical basis for considering the course of expansion. According to the returns issued by the Electricity Commission, the distribution of consumption among the main sections from 1920 onwards was as follows:

TABLE LX—DISTRIBUTION OF POWER CONSUMPTION IN GREAT BRITAIN

Year.	Power (per cent).	Lighting and Domestic (per cent).	Traction (per cent).
1920-21	71·4	16·5	10·7
1921-22	67·4	19·5	11·5
1922-23	67·7	18·9	10·3
1923-24	69·1	20·0	9·3
1924-25	69·3	20·3	8·8
1925-26	67·1	22·2	9·1
1926-27	64·2	24·6	9·6

In seven years, therefore, the percentage represented by power, which covers industrial and commercial applications, has declined by 10 per cent, lighting and domestic has increased by 50 per cent, and traction has fallen by 10 per cent. If we examine American statistics for the year 1927, we find that power represented 61 per cent, lighting and domestic 29·2 per cent, and traction 8·3 per cent. Using these American figures as indicative of the ultimate balance which will probably be established in the distribution of demand, we can assume that, under full development, the following proportions will be reached in Britain:

Power	61 per cent
Lighting and domestic	29 " "
Traction	7 " "
Other supplies	3 " "

Thus distribution represents one point of importance in our calculations.

ORGANIZATION AND GROWTH OF THE HOME MARKET

In the second place, the supply of electricity in this country is met from three sources: (1) the public supply undertaking, (2) railway, tramway, and non-statutory undertakings, and (3) the private industrial plant. In 1923-24, authorized undertakers produced 5,397,000,000 units; railway, tramway, and non-statutory undertakings, 1,284,700,000; and industry, as far as it is possible to judge from the Census of Production, 3,280,000,000 units. Among the non-statutory undertakings, railway and tramway authorities accounted for 907,000,000 units, while, of the output of authorized undertakers, traction accounted for 502,000,000 units. This gives a total production on traction account in that year of 1,409,000,000 units. In the same year, power accounted for 69.1 per cent of the total output, which is equivalent, therefore, to 3,730,000,000 units. Using these figures we obtain the following results:

Category.	Type of Undertaking.	Output (Units).	Totals (Units).
Power	Authorized undertakers	3,730,000,000	} 7,010,000,000
	Private industrial plant	3,280,000,000	
Traction.	Authorized undertakers	502,000,000	} 1,409,000,000
	Railway, tramway, and non-statutory undertakings	907,000,000	
Lighting and domestic	Authorized undertakers	—	,080,000,000
Other purposes	Authorized undertakers	85,000,000	} 453,000,000
	N.S. undertakings	368,000,000	
Grand total	9,952,000,000

We can now use 1923-24 as the basis for future calculations.

A third fact of importance lies in industrial electrification. According to the Census the total capacity of all power plant in industry was about 15,494,000 H.P., and, of this, electric motors represented 7,942,000 H.P. At the present time American industry is electrified to the extent of 78 per cent, so that, if this country had reached the present state of electrification ruling in the United States, the capacity of electric motors would have been about 12,000,000 H.P. From study of consumption figures per H.P. of electric motors installed in leading manufacturing towns in Britain, the average consumption is 670 units per H.P., which would correspond with an output of 800 units. We can expect this, however, to rise under better industrial conditions to at least 1000 units, so that the output represented by industrial demand would amount to 12,000,000,000 units. We should also make allowance for the expansion of equipment in industry generally, but in this case it is impossible to use American statistics, owing to the fact that Britain industrially is already highly developed, while the United States is in process of

SUMMARY OF FUTURE DEMANDS FOR ELECTRICITY

expansion. Even so, the increase in the total motive power in industry in the United States over the seven years, 1919–25 inclusively, is 22 per cent, equivalent to 3·6 per cent per annum. We should expect in this country a much slower rate of increase. By 1940, for example, we should expect the total motive power capacity of industry to have increased by 25 per cent, and the electricity output for industrial purposes would then be 15,500,000,000 units.

A fourth item of importance lies in the commercial demand, which, as American experience has shown, bears a fairly steady ratio to the industrial, and the limits in this country would become, using American ratios, 4,500,000,000 units for commercial demand. Using American statistics again, domestic consumers in 1927 were given as 17,860,000, equal to 15·5 per cent of the entire population, each consumer being responsible for an output of 500 units. We should expect the corresponding British total on a production basis to be 3,400,000,000 units. In agriculture, which is another source of potential demand, according to the Census carried out by the Electricity Commissioners, the total capacity of all engine power in 1925–26 lay between 500,000 H.P. and 600,000 H.P., electric power consumption accounting for only about 2,000,000 units. German statistics showed that, in 1925, with an acreage practically three times that of Britain, the capacity of all engine power in German agriculture was 4,005,225 H.P., with electric motors accounting for 3,334,000 H.P. We should expect agriculture to consume 600,000,000 units, which would be equivalent to a power production of 720,000,000 units. Traction, a further source of demand, accounted in 1923–24 for a total production of 1,400,000,000 units. There may be a slight increase in suburban railway electrification and extension of the tube system to provincial centres, but against this expansion must be placed the steady decline in tramways, and it would be dangerous to assume a production on traction account greater than 2,400,000,000 units.

Adding up all these items, we can establish the limits of production during the next twelve years as follows :

TABLE LXI—TOTAL POTENTIAL POWER PRODUCTION IN GREAT BRITAIN

Category.	Output (Units).
Industry	15,500,000,000
Commercial	4,500,000,000
Domestic	3,400,000,000
Agriculture	720,000,000
Traction	2,400,000,000
Other purposes	2,000,000,000
Grand total	28,520,000,000

ORGANIZATION AND GROWTH OF THE HOME MARKET

Two items in this table are capable of considerable expansion—namely, traction and agriculture. We have assumed that main-line electrification will not be introduced to any great extent, and that rural industries will not be an important feature in economic development during the next twelve years. Judging from results obtained in other countries—notably Switzerland, France, and Germany—we would expect a total consumption in excess of 11,000,000,000 units if all the railways without exception were electrified, but vested interests are strong enough to ensure that this will not take place. It would be a mistake to count on main-line electrification, although there will probably be an intensification of suburban railway electrification, for which due provision has been made.

We can assume that the limits of rapid development are those given in this table. When this output has been reached only a national expansion consequent on an increase in population and in financial and manufacturing resources will affect the consumption of electricity. We have already seen that the motive power equipment of industry increases about 2.5 per cent per annum, while the expansion of economic activity generally, apart from industrial production, would probably lie between 3 and 4 per cent. We should not expect, therefore, after this first period when a saturation point has been reached in electrical power production, that an annual increase thereafter of more than 4 to 5 per cent would take place.

The Weir Report stated that, by 1940, the total national consumption of electricity would be 21,385,000,000 units, which would be equivalent to about 24,000,000,000 units produced. Examination of the particulars of the regional schemes published by the Electricity Commissioners, where the annual output, given as about 3,360,000,000 units for 1923–24, is calculated to become 17,585,000,000 units by 1941, shows that the estimate given in the Weir Report has been very slightly exceeded. According to those calculations, the national output of electricity in 1941 would be about 26,000,000,000 units. For this output to be reached, we must assume :

- (1) That the entire public supply of electricity will be concentrated in undertakers recognized under the national scheme ;
- (2) That the private industrial plant will slowly but surely be closed down and supply be taken from the public undertakings.

If we examine the statistics of optimum production already given, we find that, omitting industry, the total production becomes about 13,000,000,000 units. This means, assuming this demand has been entirely developed, that industry itself must account for about 12,000,000,000 units of the output of authorized undertakers, the

TOTAL NATIONAL CONSUMPTION OF ELECTRICITY

private industrial plant accounting for 3,500,000,000 units. The point at issue is this: are we justified in assuming that the conversion from industrial to public supply will be as complete as these statistics show? In 1923-24, as far as it is possible to judge from the Census returns, private industrial plant produced 3,280,000,000 units, while American statistics prove that about 16 per cent of the entire national output of that country in 1927 was due to private industrial plant. 16 per cent of the maximum established by us gives about 4,750,000,000 units, so that there is expectation of more complete conversion to public supply in this country than has taken place in the United States. There is a certain amount of reason in such an assumption, because the price of electricity as quoted to the industrial consumer in this country will be very much less than that already quoted to the American industrial consumer, and cost is a deciding factor.

As a matter of fact, the curve of production since 1921 has moved in practically a straight line, and if we prolong that curve without change, we obtain in 1941 a national output of 19,500,000,000 units. This must be regarded as an absolute minimum, since no allowance has been made either for the effect of the national scheme on the consumption of electricity, or for the process of conversion from private industrial to public supply. Allowing for these two factors, the real figures in 1941 would be, as far as we can judge, about 23,750,000,000 units. To this must be added the remaining output by private industrial plant, which we think would not be less than 4,750,000,000 units, the final figure being in that case about 28,500,000,000 units for the entire national output from all sources.

These calculations are purely tentative, but they are interesting as showing how future demand may be considered when all the factors influencing such a demand are weighed carefully for their effect. It is along these lines that economic theory and statistical investigation would be of greatest value to industry generally.

The main purpose of this chapter has been to show that, even with a comparatively rapid expansion of electrical power consumption in the country as a whole, there is still room for acceleration of demand. The temptation to accept the position as it is and to allow the industry to evolve without any special effort on the part of those in charge of it may be fairly strong when attention is devoted only to British statistics, but Britain is not a self-contained country. It is dependent on a very large volume of export trade and its prosperity has been built up on the efficiency of its great industries. No industry, therefore, can avoid an international comparison, and when such a comparison is applied, it becomes evident that in the world movement towards electrification Britain is not playing a particularly distinguished part. Of the ten countries examined, for example, Britain comes last, and that is a position

ORGANIZATION AND GROWTH OF THE HOME MARKET

which must be profoundly disturbing to those who have been studying the course of international competition.

We have shown that there is room for a stimulation of national demand within definite limits as imposed by the present equipment of industry and the state of national prosperity, and it should not be impossible for the limits we have established to be reached within twelve years. It should not be assumed, however, that the potential market as established represents the limit of possible advance. As we show in a later chapter, in the domestic and agricultural spheres alone there is room for almost indefinite expansion, but one cannot foresee with any confidence when a saturation point will be reached. It is certainly not to be found in the immediate future or even in twelve years' time.

THE REORGANIZATION OF ELECTRICITY SUPPLY

CHAPTER V—THE REORGANIZATION OF ELECTRICITY SUPPLY

I.—THE BACKGROUND

IN the previous chapter we have shown that, with a fairly rapid advance in electrification since 1920, the relative position of Great Britain in this movement was unsatisfactory even if all allowances had been made for trade depression and administrative difficulties. The truth of this has been apparent to leading engineers, economists and politicians ever since 1919, and chief among the proposals put forward during the years of inquiry immediately before and after the conclusion of the war was that of the development of a régime of large scale electrical power production. Such a régime was considered necessary to the realization of a strong competitive position on the part of the basic industries. Coupled with this was, of course, the theory of coal conservation, but it would be a mistake to assume that the mere purpose of reorganization was to cut down coal consumption and effect economies in fuel costs.

The main motive was something quite different. It was that of rationalization of electric power production in this country with a view to stimulating more effectively demand through reduction in price resulting from reduction in cost, such a stimulation being so great that the consumption of coal over the industry as a whole would not be decreased but actually increased. Coal conservation has not been altogether the main motive in the centralization of electricity supply, although, as we have already indicated in a previous chapter, recent technical changes have led to very great economies indeed. The main principle at issue was that of accelerating the electrification of industry, of making more widely available electricity for all purposes, domestic, commercial, agricultural, and industrial, and thus ensuring constant and increasing employment among an entire range of industries feeding into electrical manufacture and dependent on electricity supply for their motive power.

We have indicated the limits of this potential market if industry is alone considered, but, in a country with a growing population and with an enormously complicated system of trade and exchange, it is a condition of existence that production should increase, that industrial equipment should increase to correspond with this production, that the national economy and national activity generally should show, with few interruptions, a state of upward movement. While, therefore,

THE REORGANIZATION OF ELECTRICITY SUPPLY

the demand for electricity may be fixed on the basis of the present structure of industry, there is in reality no limit to potentialities. There is no reason why the output of electricity in this country in the future should not exceed 50,000,000,000 units instead of the 28,500,000,000 units already fixed as a preliminary saturation point.

This conception is of importance when the various efforts made to accelerate the consumption of electricity since the conclusion of the war are under review. The background stretches away to the infinite, but one can see certain boundaries where achievement can be rewarded and a new foundation laid for greater expansion. Now, ten years after the conclusion of the war, opinions have been very considerably modified regarding the potentialities of electrical development, both on the technical and economic sides, and the limits foreshadowed then have since been exceeded, but one can establish certain broad principles governing the process of rationalization in electricity supply.

The stimulation of demand has been attempted hitherto through four different channels :

- (1) Through the enterprise of individual electricity supply undertakings ;
- (2) Through the activities of bodies which are financed by the electrical industry both from its supply and manufacturing sides ;
- (3) Through the work of co-ordination carried out by the Government as represented by the Ministry of Transport and the Electricity Commission ;
- (4) Through the work of a great public utility board brought into existence by the Electricity Supply Legislation of 1926—the Central Electricity Board.

The first and the fourth of these channels are undoubtedly the most important, and we have actually no criteria for deciding the relative efficiency or inefficiency of either or both of them. Apparently enterprise on the part of many undertakings may have been less evident than one would have expected, but an examination of what has really been carried out by some of the most progressive municipalities and power companies may serve to adjust perspective.

II.—THE WORK OF THE SUPPLY UNDERTAKING

One must consider the work of supply undertakings from possibly two points of view :

- (a) That of the technical ;
- (b) That of the economic.

The supply as a whole until very recently had not developed to any great extent

THE DEVELOPMENT OF THE SUPPLY UNDERTAKING

the science of load building. Reliable statistics for the country as a whole were not available prior to the work carried out by the Electricity Commission, and it was necessary before 1920 to add up the results of an enormous number of undertakings to secure a historical purview. The industry, therefore, as a national entity had not yet evolved, and there was no real incentive for considering electricity supply as a national economic asset. The supply undertakings had no criteria which would guide them on those broad questions of policy which would link their units into the vast national organization. They had no real incentive to carry out close research into potentialities within their own areas, since they had little knowledge of the economic importance of electrical power itself. Consequently they pursued a less progressive policy with the full knowledge that their monopoly would allow them to obtain through the imposition of suitable prices a safe return on the capital invested.

It is true, of course, that the engineers in charge of such undertakings would almost of necessity have required to keep abreast of technical knowledge bearing on generation, transmission, and distribution, but the science of load building is something quite different from that of designing and equipping a power station or a transmission or distribution system. It requires, above all, a fairly accurate knowledge of main movements within industry, so that attention might be concentrated on those factors within the supply systems which would conform to those movements or would be affected directly by them.

Again, for example, it would be difficult for a supply undertaking to develop a commercial load easily and readily within a seriously depressed industry. The value of differentiation between types of industry and economic conditions; the definition of demand densities—if such a term may be used—and the possibilities of maximum penetration; the determination of an economic price, for industrial electrification purposes, for one industry or group of industries; the exact evaluation of the benefits or disadvantages to be derived from conversion to electric drive—all those considerations served to complicate and render excessively difficult enterprise as carried out by the supply undertaking. Until the industrial situation clarified, one could hardly expect to find traces of a definite development policy, and this, more than the lack of enterprise on the part of the supply undertakings, was responsible for the slow rate of growth in electrical power consumption before the war.

Since 1920, however, the position has changed in the most remarkable fashion. There is now a constant compilation and publication of essential statistics bearing not only on the state of the basic industries, on employment, on prices, and on finance under all its aspects, local and national, but there are now available, as this

THE REORGANIZATION OF ELECTRICITY SUPPLY

Monograph itself shows, very full statistics covering the consumption of electricity not only in Great Britain but in the main industrial countries. It is possible to obtain a national view covering all industries and the broad economic factors affecting production, and define accurately the stages of progress achieved in power consumption. New standards have been created against which achievement can be measured, and, through the reality of such a wider view, local enterprise is becoming more conscious of a national background and of a national entity.

The effect of this on a load-building policy must be very great, and we are only now beginning to assess some of its effects at their proper value. The adoption of a national power policy, with its interpretation through a number of broad economic changes and adjustments, may become reality in a very short time. The individual supply undertaking is formulating, slowly but surely, a new type of constructive policy which, while covering local needs, serves also to further national needs. The best evidence of such a change can be found in the acceptance given to the proposals of the Central Electricity Board by the supply undertakings. All of those factors lie in the economic and essentially progressive sphere.

In the technical sphere, more revolutionary changes still have taken place. The technique of generation, transmission, and distribution of electricity has been modified almost beyond recognition since the conclusion of the war. There is a better appreciation of the capital value of central station efficiency. There is a more exact evaluation of the benefits to be derived from equalization of load and the more effective standardization of consumers' apparatus. There is also in operation a desire to study the most important scientific and technical achievements of other countries in the power field, with a view to introducing some part of those achievements into current technical practice. The improvement that has taken place in power station efficiency, as recorded on pages 38-39 of this Monograph, is a direct illustration of this movement.

Technically and economically, therefore, the power supply industry is moving forward rapidly, and the accusation of lack of enterprise cannot be applied justly to electricity supply undertakings as a whole in this country. It still refers to a few isolated undertakings, but not to the majority of them. That in itself is an achievement; but we have not yet been able to benefit entirely from it, and the enterprise of the supply undertaking has still to exert its full weight on the development of electrical power consumption. Its main strength lies in the future and its performance will be of greater benefit several years hence than it has been in the past.

The examination of the average prices charged for electricity, as recorded in the following table, for the period 1921-22-1926-27, shows that a considerable effort

PROGRESS OF TYPICAL UNDERTAKINGS IN GT. BRITAIN

TABLE LXII—THE PRICE OF ELECTRICITY IN GREAT BRITAIN

Average Revenue in Pence per Unit Sold

Classification.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.
Lighting and domestic	5·75	5·30	4·52	4·20	3·82	3·55
Public lighting	2·90	2·45	2·31	2·10	1·96	2·61
Traction	1·73	1·45	1·36	1·29	1·13	1·17
Power	1·69	1·30	1·14	1·07	1·00	1·14
All supplies	2·48	2·07	1·86	1·75	1·65	1·76

has been made by supply undertakings to bring their prices down to a level where the demand for electricity could be stimulated and the rate of expansion accelerated. Thus the average price obtained for lighting and domestic purposes per unit sold in 1921-22 was 5·75*d.*, while in 1926-27 it had fallen to 3·55*d.* Traction showed an even greater reduction, from 1·73*d.* to 1·17*d.* per unit, power 1·69*d.* to 1·14*d.*, and, if allowance is made for the operation of the coal clauses during the coal strike period and its effect in increasing the charge for electricity, the average charge for power must now be less than 1*d.* per unit. Those reductions are not so great, however, as the average fall in wholesale prices since 1921; but, on the other hand, the increase in the charge made for electricity did not rise to such a height compared with 1913 as wholesale prices during the boom

TABLE LXIII—ELECTRICITY SUPPLY IN GREAT BRITAIN

Undertaking.	Units Generated.		Increase Per Cent.
	1921-22.	1928-29.	
	(Millions.)	(Millions.)	
Manchester Corporation	213·3	474·2	122
County of London Electric Supply Co.	68·2	404·0	540
Birmingham Corporation	123·6	376·6	205
Glasgow Corporation	164·5	341·5	108
Liverpool Corporation	106·2	293·4	176
Clyde Valley Electric Power Co.	122·1	265·4	117
Sheffield Corporation	130·8	249·7	92
Lancashire Electric Power Co.	61·4	187·9	206
North Metropolitan Electric Supply Co.	65·0	182·6	180
Yorkshire Electric Power Co.	59·2	172·6	193
Leeds Corporation	68·4	162·8	138
Edinburgh Corporation	42·7	138·1	224
Shropshire, Worcester and Staffordshire Electric Co.	45·5	118·4	160
Bristol Corporation	44·2	109·8	148
Entire country	4884·7	10,879·0	122

THE REORGANIZATION OF ELECTRICITY SUPPLY

period. The result is that in electricity supply something like a pre-war average price now obtains.

In the progressive undertakings the effect of such price reductions has been to accelerate power production, and we have chosen a number of the undertakings representative of the movement. It must be understood that such a selection is made for purposes of record only and does not amount to a distinction between such undertakings and other supply undertakings operating in this country. As far as the supply industry is concerned, quite a considerable effort has been made during the post-war decade to stimulate demand, and the future should show a very considerable strengthening of this movement, with a wider range of effectiveness.

III.—THE STIMULATION OF DEMAND

It is obvious, however, that electricity as a commodity must be brought to the public conscience either through adequate pictorial publicity and other propaganda methods in line with the American principle of mass-suggestion, or through the dissemination of information bearing on the commodity and its services to the community as a whole. If an atmosphere favourable to electricity is created, then development can be much more rapid and a greater reward obtained for any enterprise destined to promote public interest in electricity.

It is rather difficult in a survey of this nature to discuss at all adequately what has been done in this connection, since we are interested more in economic aspects than in pure propaganda; but the final justification of all publicity is economic, and the change in the public attitude towards electricity during the last five years especially has been one of the most remarkable phases in the social evolution of Great Britain. There has been undoubtedly exaggeration and too enthusiastic adherence to the idea that electrification is going to solve most of our industrial, economic and social ills, but it is better to have such enthusiasm than to have sheer indifference or animosity.

As far as the electrical development associations are concerned, effort has been concentrated more on local penetration and co-operation with the supply undertakings than on a big national campaign, and, in this respect, the policy pursued by Great Britain has been quite different from that carried out in the United States and especially by the central organization, the National Electric Light Association. Considerable attention has been devoted to the activities of the N.E.L.A. and in some features they can be reproduced in this country, but it has not yet been decided to the satisfaction of those who are intimately connected with the power

FACTORS AFFECTING THE FUTURE OF POWER EXPANSION

industries that the method of local penetration, with an ultimate extension of such activities to cover a national range, is not better suited to the psychology of this country than a sweeping national display. There is also this point of very considerable significance—namely, the fact that opinion in the United States is already changing. Concentration on lighting, domestic, and commercial demand is no longer considered the one and only function of a central development association. The broader industrial and economic aspects are becoming more important. There has also been the danger that, in the policy of price differentiation that must be carried out by the supply undertaking, the industrial and large power interests would suffer for the domestic.

The future of electric power expansion in this country lies, above all, with industry, and the low density of electricity consumption in this country since the conclusion of the war, in comparison with the United States or Germany, has been due, above all, to the fact that a severe industrial depression has rendered it impossible for the industries to reorganize their equipment and carry out extensive manufacturing schemes. The most important potential market open to electricity lies in industries already established and in the development of new industries supplementary to the old as factors in the creation of national economic wealth.

While, therefore, the greater part of the effort made by the manufacturers themselves through their central association has borne more on the industrial rather than on the domestic and lighting demand, the assumption has been that, with a revival of industry and with the realization of a higher standard of economic prosperity, the work of electrification in every branch would become simpler and much more rapid. There is a surplus available for expansion of industrial equipment, while the consuming power of the public is increased to a point where it can aim at higher standards of domestic comfort. The development of an electrical demand without consideration of the broad economic factors defining the purchasing power of the public can at best only be partially successful and its results disappointing. The aim, therefore, of any association desirous of accelerating electrification must be to contribute as much as possible, through direct contribution and through informed criticism, to the elaboration of a national economic policy which will ensure a revival of industry and the realization of a higher standard of economic prosperity than at present obtains. It is from this point of view, above all, that the work of the Central Electricity Board will be judged. There may in the future be created a central organization for the entire industry aiming at a much more ambitious development programme than has yet been conceived.

THE REORGANIZATION OF ELECTRICITY SUPPLY

IV.—THE WORK OF THE ELECTRICITY COMMISSION

It is unnecessary now to examine in detail the history of electricity supply in this country since the preparation of the Coal Conservation Report in 1917. It belongs to a record of the past which, while significant and important at the time, has since been displaced by greater achievement and will disappear from view behind the promise of still greater achievement in the future. At the conclusion of the war it was clearly recognized that the future of Britain as a great industrial country depended on more effective utilization of its resources in materials and power. As part of the work of reorganization bearing on national economic activities—evidence of which can be seen in the grouping of the railways and in the emergence of the five joint-stock banks—it was proposed that the public utilities should, as far as possible, be co-ordinated under a central scheme. In this way, progress based on the observation of the most complete measure of economy combined with the realization of high productive capacity could be carried out with success.

The electricity supply industry, which had become an enormously complicated mass of individual undertakings supplying single areas, with no connection between areas and no national policy to guide even developments within the areas already delimited, presented a problem of very great difficulty. It was necessary, first of all, to co-ordinate developments so that duplication and inefficiency would be avoided and units would be created which would have full economic justification. On paper such a consummation appears to be comparatively easy, but everything had been against the rational development of electricity supply. Legislation had been entirely unsuitable since the first Electricity Supply Act of 1882, and it was calculated to hinder the natural growth of supply undertakings. In addition to this, no uniform body had come into existence to carry out the supply and distribution of electricity. Local authorities, as represented by county councils, municipalities and even rural district councils, existed side by side with private supply companies working on the joint-stock principle. Industrial companies, notably in coal-mining and iron and steel, were selling their surplus energy to large consumers and even to municipalities; tramway and railway authorities had their own generating stations, and even individuals were carrying out the work of power generation and distribution.

The problem to be faced was, therefore, the simplification of types of organization, co-ordination of the activities of undertakings within the areas which formed

THE CO-ORDINATION OF ELECTRICITY SUPPLY

economic power zones and, finally, co-ordination of those zones in a national scheme. The difficulties confronting any body created to carry out such reorganization were enormous. It could not be expected that local bodies or power companies in possession of rights granted by statute would be willing to become amalgamated in larger groups and thus lose much of their individuality. The only alternative to compulsion and its inevitable consequences in nationalization was some form of co-operation which might have behind it the threat of compulsion. It would not be advisable to interfere with rights already granted by Parliament, but it might be possible to effect some work of co-ordination through the voluntary co-operation of the undertakings themselves.

The electricity supply industry was peculiar in this sense, that it could be a wholesaler at the same time as a retailer of electrical energy. It might be a mark of inefficiency to have an enormous number of small producers, but the multiplication of distributors, all engaged on creating and expanding demand, could just as easily be a mark of enterprise and of efficiency as of inefficiency. It might be possible, therefore, to effect some demarcation of function, co-ordinate production and still maintain undertakings in existence by virtue of their value as distributors. In a country like the United States, where the public supply company was in the ascendant and the national temperament lent itself easily to mergers and amalgamations, the work of centralization and of co-ordination was carried out largely as a result of general economic tendencies within the country itself. The large power supply corporation could not compete with other power corporations owing to the existence of territorial monopolies, but it could buy them up, and so in the process of time a very large concern with giant power stations and supply areas covering many thousands of square miles evolved. There was little necessity for intervention on the part of the State itself.

A similar observation applies to Germany, with, however, the curious development that the very large supply company has been able to take over municipal plants, while the State itself has obtained a large holding in the leading supply companies. Progress has been conceived, therefore, on the lines of joint-stock ownership with a measure of Government participation and, in some cases, of control. The result has been that Germany, like the United States, is now mapped out into very large power zones dominated by single undertakings with very great technical and financial powers. A similar development has taken place in Italy, partly in direct imitation of American methods and partly as the result of the State taxation and subsidy policy. Only a very large undertaking could benefit from the subsidies extended by the State for expansion of electricity in agricultural and outlying areas.

THE REORGANIZATION OF ELECTRICITY SUPPLY

In other countries the natural tendency towards financial mergers and amalgamations has been such as to bring with it the formation of large power production and distribution units and ultimately, through working agreements between such units, the national reorganization of electricity supply.

One would have thought, therefore, that in this country a similar development could take place, but the emergence of the very large public utility company was rendered extremely difficult for territorial and for administrative reasons. It is obviously impossible to bring two companies into close association and interconnect their systems when they are separated by a stretch of neutral territory which cannot be absorbed. Such stretches of neutral territory have been represented in this country by municipal undertakings, and the fact that at the present time local authorities and municipalities account for 65.3 per cent of the electricity sold by public undertakings, while the companies only account for the remaining 34.7 per cent, is sufficient to prove that this difficulty could not readily be surmounted. Even if all the companies in the country were amalgamated, they would not control much more than one-third of the national productive capacity or the national output. When, in addition to this, one takes into account the fact that the areas of supply of the companies are widely scattered outside of London and do not lend themselves easily to any centralized control, the difficulties confronting national reorganization become apparent.

Legislation played also a part in retarding the process of amalgamation, since it was calculated to wall in undertakings by legislative rights, which were sufficient to protect reactionary concerns from any movement destined to absorb them and render them more efficient. The Electricity Commission, which came into existence as a result of the legislation of 1919, with powers to control the provision of new generating plant on the part of both local authorities and companies and to determine conditions of supply and interchange, had, nevertheless, no authority to bring together local authorities into one central co-ordinating body, and it had still less authority to complete amalgamation of the companies, even if under conditions existing in Britain such amalgamation had been possible.

It was necessary, first of all, to carry out a very strong educative campaign; secondly, to create a national conception of the industry as a whole and to illustrate quite clearly what had been and what might be achieved. The most valuable work of the Commission, quite apart from any administrative action carried out, lay in calculating and co-ordinating essential statistics bearing on electricity supply and on the efficiency of generation. In this way national standards were created by which local performance could be measured.

THE WORK OF THE ELECTRICITY COMMISSION

Again, the method adopted by the Commission—namely, that of the arbitrary delimitation of power zones known as Electricity Districts, where a central board composed of representatives of supply undertakings within the district could function on a basis of voluntary co-operation—was the best that could be evolved, short of actual compulsion, and for the latter no legislation existed. In view of the individualism and the strength of the forces of tradition inherent in British industry and, above all, in local administration, the fact that a number of such districts was finally determined is sufficient evidence of enterprise not only on the part of the Commission but also on the part of the supply undertakings. A number of these districts—namely, South-East Lancashire, South-West Midlands, London and Home Counties, Mid-Lancashire, East Midlands, West Midlands, Edinburgh and Lothians—have now been in operation for several years and, through co-operation, have carried out very important measures of co-ordination, standardization, and interconnection. The work carried out by the South-East Lancashire Board has led to quite a remarkable improvement in the conditions and status of electricity supply in Lancashire, with the result that very great economies have been effected both in fuel consumption in generating stations and in the distribution of electricity. Consumption has increased very rapidly as a consequence.

If the whole country had been divided into areas as effectively administered as South-East Lancashire, the problem of co-ordination and of the national reorganization of electricity supply would have been solved. But it was found impossible to make the scheme as applied to the whole country a complete success.

The Weir Committee met to discuss this whole question five years after the Electricity Commission had been established, and they carried the process of change much further. They proposed that the voluntary system which had hitherto been in operation should be supplemented by some measure of compulsion—a measure which would not destroy entirely enterprise and nationalize the industry, but would reproduce in Great Britain some of the advantages which a very large power corporation had reached in the United States and in Germany.

The main findings of the Committee were largely a confirmation of the policy pursued by the Electricity Commission since 1919, with, however, definite suggestions for the solution of the main difficulties confronting the Commission in its work of reorganization. It should be recognized, of course, that, without the preliminary work carried out by the Commission, the recommendations made by the Weir Committee would not have been carried out easily. The main proposals were that the distribution and selling sides of electricity should not be handled and that a clear line of demarcation should be drawn between production and main trans-

THE REORGANIZATION OF ELECTRICITY SUPPLY

mission on the one side and distribution on the other. Reorganization could bear most usefully on the former, since it lent itself easily to centralized production in large units and to standardized methods. It was impossible to expect supply undertakings to distinguish between their activities as producers and as distributors, and the Committee proposed, therefore, that a new organization should be brought into existence which would take over production and main transmission of electricity for the country as a whole and retail electricity to the supply undertakings at an ascertained cost of production.

The justification for the creation of such a central organization was to be found in the work it could carry out in the direction of co-ordination of power production throughout the whole country, with a view to the realization of the maximum economies and the reduction in the national average cost ruling at the present time. Such economies would be effected by the concentration of production within a limited number of modern power stations operating at a higher level of efficiency with reduced fuel costs, such stations to be interconnected by main transmission lines operating at 132,000 volts. Interconnection would improve the load factor on each station, cut down the necessity for housing in each station a high percentage of reserve plant, since, under the new scheme, a number of stations would take the base load, a number would take the intermediate load, and a third set would take the peak load and act as reserve. To render possible this work of interconnection, frequency of transmission should be standardized at 50 cycles, since the greater percentage of existing plants were operating at that frequency.

For purposes of initial survey, the entire country would be split up into a number of super-power zones, which would ultimately be brought into a single power zone. The new organization brought into existence to carry out this scheme should be a public utility formed on the joint-stock principle, with representatives of the main interests concerned in the national supply of electricity. It should, in some details, be subject to the Ministry of Transport, but in administration, both financial and technical, it should be independent of all political or local influences. It should be vested with sufficient powers to overcome opposition where such opposition had little or no justification. In addition to the voluntary co-operation, as attempted by the Electricity Commission in its work of delimiting Electricity Districts, there would be an element of compulsion sufficient to overcome ultimately the resistance of the most reactionary undertakings. It is unnecessary to discuss at this point the Electricity Supply Act of 1926, which brought the Central Electricity Board into existence, since we are concerned more with results than with the detail of technical, financial, and legal administration.

SUPERPOWER OR MEDIUM-SIZED POWER STATIONS

V.—THE NATIONAL POWER SCHEME

The Electricity Commission, which is now entrusted with the work of surveying the new super-power zones and in preparing schemes for co-ordination within them, has split Great Britain up into, roughly, seven main zones. They are : Central Scotland, North-West England, North-East England, Mid-East England, Central England, South-East England, and South-West England, with the addition of smaller areas in Southern and Northern Scotland. In place, therefore, of the original fifteen districts, which did not entirely cover the area of Great Britain, there are now at most seven large zones, each of them capable of development on a large scale and with a demand sufficient to justify the selection and operation of large new generating stations. The Weir Committee proposed that the number of generating stations should be reduced to 60 instead of 564 at present existing, but such a reduction proved too drastic a step for those responsible for the surveying of the new zones, and the result has been that probably more than 100 selected stations will be responsible, by 1940, for the national output of electricity. Developments in operating efficiencies during recent years have shown that a medium-sized and even a comparatively small station can obtain results as good as those recorded in very large power stations and show greater elasticity in operation. The national scheme has, therefore, been modified to take care of these developments and ensure that the production of electricity will be carried out as efficiently as the national resources will allow.

An examination of six of the areas already surveyed—namely, South-East England, Central Scotland, Central England, Mid-East England, North-West England, and North-East England—shows divergence in the sizes of the new generating units specified by the Electricity Commission. The position is illustrated in the following table.

Out of a total of 4,366,750 kilowatts it is evident that 50,000-kilowatt sets are in the majority, being responsible for 55 per cent. Thereafter should be placed units of 60,000 kilowatts, responsible for 16.5 per cent, and units of 25,000 kilowatts, responsible for 9.7 per cent, the three sizes accounting, therefore, for an aggregate of 81.2 per cent. Since these schemes were drawn up, certain modifications have occurred in connection with orders actually placed. Thus the capacity of the first set for Hackney Borough Council has been increased from 20,000 kilowatts, as specified in the South-East England scheme, to 30,000 kilowatts. An additional unit of 30,000 kilowatts has been ordered by West Ham, and the first two sets to be

THE REORGANIZATION OF ELECTRICITY SUPPLY

TABLE LXIV—CAPACITY OF GENERATING PLANT IN GREAT BRITAIN
(Extensions 1928-1941)

Number of Units.	Capacity (Kilowatts).	Aggregate (Kilowatts).
1	6,000	6,000
1	6,250	6,250
2	10,000	20,000
3	12,000	36,000
2	15,000	30,000
6	20,000	120,000
17	25,000	425,000
2	30,000	60,000
1	32,000	32,000
2	35,000	70,000
1	40,000	40,000
48	50,000	2,400,000
12	60,000	720,000
Sizes not specified	—	401,500
—	—	4,366,750

installed at Battersea Station of the London Power Company have not a capacity of 60,000 kilowatts each but of 67,200 kilowatts. Battersea Council placed an order for 32,000 kilowatts instead of the 10,000 kilowatts specified. There has been, therefore, considerable modification in the South-East England scheme alone, but in the other areas the programme of the Central Electricity Board has been observed without serious change. It is clear, therefore, that the national power scheme will be equipped with generating units with an average capacity in excess of 40,000 kilowatts. Such a capacity has been chosen in preference to the very large composite units now being manufactured for Germany and the United States, units reaching from 80,000 to 220,000 kilowatts in one combination, largely because conditions of load would render such very large aggregations less economical in their operation than those selected. The national scheme must combine, as far as possible, the merits of centralized production, elasticity in operation, and rapid adjustment to varying demands rendered necessary by the system of interconnection.

Again, the giant power station, which has been so marked a development in the United States, where stations with a total capacity of more than 500,000 kilowatts are in operation, is not considered necessary to the successful working of the scheme. Thus, in the most extensive area, South-East England, the new stations at Battersea and Fulham are expected to reach under full development 360,000 kilowatts. In North-West England, Clarence Dock will be rated at 300,000 kilowatts; in Central

CAPITAL POWER STATIONS UNDER THE SCHEME

England the two largest stations will be Hams Hall with 240,000 kilowatts and Ironbridge with 200,000 kilowatts. In Mid-East England the largest station will be that owned by Leeds Corporation at Kirkstall with 150,000 kilowatts, followed by the Prince of Wales Station at Rotherham with 134,000 kilowatts. In North-East England two stations will exceed 200,000 kilowatts each—namely, Dunston (245,000 kilowatts) and the combined Carville Stations (250,000 kilowatts), followed by North Tees with 160,000 kilowatts; while, in Central Scotland, Dalmarnock with 180,250 kilowatts, Portobello with 162,500 kilowatts, Clyde's Mill with 137,500 kilowatts, and two new stations, each of 100,000 kilowatts, will be responsible for the greater part of the output. In South-West England the Portishead station will probably run to a final capacity of more than 300,000 kilowatts, so that, over the country, as a whole, there will be only a very small number of stations aggregating more than 250,000 kilowatts, and the greater part of the national production will be carried out by what must be regarded as comparatively small stations. As we have shown in page 39 of this Monograph, the results obtained in this country with such stations have been higher than might have been expected several years ago, with the result that a certain modification has taken place in technical opinion regarding the very large station.

The main function of the Central Electricity Board, as already described, has been that of co-ordinating power production throughout the main power zones as determined by the Electricity Commission, and one great advance has already been achieved—namely, that of consistent development over twelve years until 1941. As such, it is one of the most important examples of demand forecasting and of the adjustment of productive capacity to potential consumption to be found in any country.

A further activity of the Board has lain in the standardization of frequency, and this work of conversion is of most importance for consumer's apparatus. Large areas—namely, the West of Scotland and the North-East Coast area and part of Central England—all of first-class importance from the industrial standpoint, have been operating on a non-standard frequency; but, in view of the danger to the course of industrial production caused by abrupt conversion and the substitution of new equipment, the work carried out by the Central Board has been one of a certain difficulty. Standardization next to interconnection is, however, essential to the efficient operation of the national power scheme, and it is now being carried out.

The main justification for the Central Board's activities lies above all in the influence it will have on the price of electricity itself. It must be able to produce electricity at a lower average price for a district than that ruling generally, and this

THE REORGANIZATION OF ELECTRICITY SUPPLY

price must be such as to attract the large industrial consumer if rapid expansion in demand is to take place. The intention has been to fix a uniform average for each zone as determined. Thus, in Central Scotland, by 1934 the average price realized by supply from the Central Board will be slightly less than *4d.* per unit. This covers generation and transmission but not distribution. In South-East England the corresponding figure will be *·51d.*; in Central England, *·364d.*; in North-West England, *·378d.*; in Mid-East England, *·389d.*; and in North-East England, *·317d.*; so that the national average as retailed by the Central Board to the supply undertaking would lie between *·35d.* and *·40d.* per unit. The national average working cost of electricity in 1925-26, excluding distribution and management but including only generation, was *·52d.*, and in 1926-27, the year of the coal strike, *·71d.* To these figures should be added, however, capital charges incurred in generation which would probably add about *·15d.* per unit to the figure already quoted, so that the comparison lies between the present figure of *·67d.* per unit and about *·40d.* This means that the national scheme should result in a reduction in the cost of energy by more than one-third, and it should be possible for industry to obtain its supplies at an average figure of not more than *·6d.* or *·7d.* per unit and, in the case of very large concerns of *·5d.* Such quotations must be sufficient to justify industrial executives in carrying out electrification, while it should not be impossible for main line electrification to be undertaken on the basis of an even lower charge. The main objection to such electrification—namely, the high cost of electricity—disappears when confronted with the economies to be effected by the Central Board.

The total expenditure to be incurred by the Central Board, including capital interest, may be given as follows :

Central Scotland	£5,125,284
South-East England	8,161,658
Central England	5,659,079
North-West England	5,337,954
Mid-East England	2,907,156
North-East England	7,094,537
Total	£34,285,668

The expenditure noted in the table covers the erection of main transmission lines, standardization of frequency and capitalized interest during the first five years. It also includes, in the case of South-East England, expenditure by the London and Home Counties Joint Electricity Authority. The total for the schemes determined is in excess of £34,000,000, and will probably amount to about £37,000,000 for the entire country before the national scheme will have been completed. To this

THE CAPITAL EXPENDITURE ON GENERATING PLANT

expenditure must be added that incurred by supply undertakings in the extension of existing selected stations and in the erection of new stations. We give below statistics covering expenditure during the first five years of the scheme in the six areas determined as well as an estimate of the total expenditure which will be incurred by 1941. For the entire country such expenditure will very probably exceed £63,000,000. The total expenditure, therefore, in connection with the national supply scheme could be given as about £100,000,000 by 1941.

TABLE LXV—CAPITAL EXPENDITURE ON GENERATING PLANT AND MACHINERY

Estimates of Central Electricity Board

Scheme.	Year.	Total Extensions (Kilowatts).	Total Capital Expenditure on Generating Plant and Machinery.	Total Expendi- ture per Kilowatt.
South-East England . . .	1933-34	360,000	£5,654,100	£14·8
North-West England . . .	1934-35	311,000	4,003,000	12·9
North-East England . . .	1935-36	75,000	775,000	10·3
Central England	1934-35	162,500	1,975,000	12·2
Central Scotland	1933-34	56,250	850,000	15·1
Mid-East England	1935-36	125,000	1,709,594	13·6
Total . . .	—	1,109,750	£14,966,694	£13·6

Based on Estimates of Central Electricity Board

Scheme.	Year.	Total Extensions (Kilowatts).	Total Capital Expenditure on Generating Plant and Machinery.
South-East England	1940-41	1,310,000	£19,400,000
North-West England	"	1,086,000	14,000,000
North-East England	"	445,000	4,590,000
Central England	"	662,500	8,100,000
Central Scotland	"	481,250	7,250,000
Mid-East England	"	382,000	5,200,000
Total . . .	—	4,366,750	£58,540,000

It may be interesting, as a result of these estimates, to establish an estimate of the total market open to the electrical and allied manufacturers during the next twelve years. The estimate is based on various ratios observed during previous years and must be regarded as highly tentative with, however, a marked tendency towards conservatism, since no allowance is made whatever for a rapid increase in

THE REORGANIZATION OF ELECTRICITY SUPPLY

the demand for electrical equipment resulting from the national scheme. Main-line railway electrification, industrial reconstruction, rural electrification, and the expansion of exports beyond the present annual shipments must all add very considerably to the total given below.

TABLE LXVI—THE POWER MARKET IN GREAT BRITAIN
(1929-41)

Class of Expenditure.	Total.
Central Electricity Board	£37,000,000
Extensions of selected generating stations (4,750,000 KW. at £13·6 per KW.)	63,000,000
Extensions of private industrial plants (1,500,000 KW. at £13·6 per KW.)	20,400,000
Distribution plant and equipment	110,000,000
Consumer's apparatus	195,000,000
Telegraphic, wireless, and other special branches	150,000,000
Supply material, accessories, fittings, porcelain, insulation, etc.	150,000,000
Contract, erection, and installation work	75,000,000
Total	£800,400,000
Exports (minus imports)	£160,000,000
Grand total	£960,400,000
Annual average	£80,000,000

The annual average is about £80,000,000, but it should rather be about £120,000,000-£150,000,000 if a genuinely national movement towards electrification is to take place. The question then remains: How can demand be stimulated to such a degree that the consumption of electricity will justify the expenditure incurred by the Central Electricity Board and make the national system function to capacity and the production of the electrical manufacturing industry be increased? In the following chapter we shall deal with this problem from the two points of view, which in ultimate perspective are as one, and discuss possibilities of action along definitely promising lines.

THE ENCOURAGEMENT AND EXTENSION
OF ELECTRIFICATION

CHAPTER VI—THE ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

I.—ELECTRICAL POWER CONSUMPTION

THE expansion of the demand for electrical power and, with it, the realization of a higher volume of production in electrical manufacture can be viewed as two sides of a very large problem which cannot be even clearly envisaged. The solution of such a problem is bound up with the revival of national economic prosperity as a whole, since, as we have already shown, electricity has become the main motive force in industry and the progress of electrification now affords a clear index of national activity. So much is this the case that, in the United States, Germany, and Italy, a new monthly index of electrical power production has been drawn up and used as one of the main elements in determining the curve of national production. In those countries the very high degree of electrification in industry renders such an index almost as reliable as that of factory employment, but conditions in this country are not favourable to a similar use. With industry only 51 per cent electrified, electrical power consumption has not yet become fully representative of the volume of employment or of activity generally.

The main directions in which electrical power consumption may be stimulated are, in order of importance: industry, transport, commerce and shipping, agriculture, and domestic services. Industry is and will be the area of greatest potential demand, and any policy aiming at the revival of industry must be favourable to the increasing consumption of electricity. Under normal conditions one would assume that the only incentive required to bring industry around to electrification on a very large scale would be that of the quotation of an economic price—in other words, a price which would justify the industrial executive in carrying out wholesale conversion within the factory to electric drive. Such conversion means, first of all, the installation of new equipment in certain processes and, at the very least, the substitution of electric motors for mechanical transmission systems, with its consequence in the scrapping of steam reciprocating primary power plant. The successful realization of such adjustment depends, above all, on the financial strength of the industrial firm. If it has been adhering to a very conservative policy and placing to reserves sufficient to cover depreciation and obsolescence of plant, then it can bear the burden of such a change without serious difficulty. It will often be found that firms in this position have already modernized their equipment and adopted electrification ;

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

only a comparatively small percentage of them still adhere to the old equipment owing to the influence of factors sufficient to neutralize immediate benefits from electrification or the technical conditions of production themselves, which would permit of satisfactory returns from the development of the principle of heat economy from existing power plants. This group of industrial firms does not represent the main difficulty in any movement destined to improve industrial efficiency and introduce more complete electrification of manufacturing processes.

It is in other and less successful firms that difficulties and complications arise. Such firms may have been unable to adhere to a conservative financial policy owing to the conditions of the market they supply, and they may have been unable to accumulate sufficient reserves to cover obsolescence. They are confronted, therefore, with the necessity of raising new capital in the open market for the purposes of re-equipment or, if unable to raise such capital easily, may be forced to obtain credits and advances from the banks. Under these conditions any revolutionary change in manufacturing equipment becomes subjected to the most minute scrutiny, and enterprise tends to disappear in the process. Conservatism may be sufficient to obstruct the reorganization of manufacturing methods and the installation of new equipment. In their case, only a very considerable revival of demand with the realization of satisfactory profit margins can have immediate effect on conversion to electric drive.

A third group may be distinguished, and this group is to be found, above all, in the basic industries. It finds itself unable to earn any profits beyond the sums required for the service of debentures and loans. It finds difficulty in putting aside sufficient sums for depreciation of existing plant without allowance for obsolescence, and it has practically no reserves available for reconstruction and improvement of productive capacity. Its credit is not sufficiently great for it to be able to obtain capital in the open market at a reasonable rate, and the conditions under which it may obtain advances and loans from the banks are very onerous. Under these conditions the policy of the executive is that of self-preservation rather than that of expansion or of immediate enterprise.

With a normal economic situation, where there would be a steady increase in the volume of production from year to year over the country as a whole, such a group would tend to become smaller and smaller, owing to the fact that improvement in the market would bring it into the second group and ultimately into the first. Since 1921, however, no such normal economic situation has obtained. There has been a regime of constant deflation and credit restriction. The market has shown a steady movement of contraction rather than of expansion, and the

ELECTRIFICATION AND PRESENT STATE OF INDUSTRY

third group has included a greater number of industrial firms every year. The result has been that whole industries, such as iron and steel and coal-mining and textiles, have not been able to realize a satisfactory profit-earning margin. They have not been able to raise new capital easily in the open market, and they have been subjected to the most adverse effects of a national financial policy which has aimed at conservation of the Gold Standard even at the cost of high money rates and a reduced demand for industrial products.

Again, the weight of taxation which, even in earlier years, was sufficient to retard enterprise and weaken competitive efficiency, has become more crushing as the volume of production has declined. Instead of declining with production it has, if anything, increased. A further consequence bears on the capacity of the basic industries to develop a strong export position. As a result of fiscal and financial policy, their costs have risen above the world costs and they have not been able to get down to a competitive level. The result has been a very great increase in the imports of manufactured goods into this country and a decrease in exports.

The return, therefore, on the capital employed in the basic industries has become less and less satisfactory every year, and the process of modernization has been interrupted. To embark, therefore, on an electrification campaign under those conditions would be to invite failure at the outset. Certain conditions must be fulfilled before electrification becomes an immediate proposition. Those conditions are found in an industrial rationalization policy. This would aim at reduction of manufacturing costs through a process of specialization and of concentration. The productive capacity of the industry would be brought into close relation with the actual volume of demand available even if, to carry out such an adjustment, it should be necessary to close down a number of older plants and narrow down activity to a few selected installations. As a necessary part of such adjustment would come revaluation of capital and earning assets to correspond with the actual earning capacity under existing market conditions. Such a process would widen the margin between costs of production and selling prices and bring the whole industry or group of firms into the second class already distinguished. Further, it would be necessary through co-operation or through amalgamation in one large combine, to ensure some control over the national production, eliminate unnecessary competition, and secure stability in prices, so that the industry would be protected from the worst effects of a falling market.

As a result of these measures, the credit status would be raised and new capital could be obtained for extensions of productive capacity and for replacement of inefficient or obsolete plant. It is at this moment that electrification becomes a

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

practical proposition and the supply undertakings can hope to secure new sources of demand through the quotation of an economic price. It is also at this moment that Government assistance can be given to an industry in order to accelerate the process towards credit stability and the realization of a higher credit status.

Developments in this country in the basic industries are moving in a direction favourable to such a consummation. Rationalization has progressed very considerably in iron and steel, and a small number of manufacturing groups is emerging, which will probably dominate production in the industry and through co-operation ensure stability in prices and a pooling of resources with a view to expansion of export trade. In coal-mining a similar movement can be traced, especially in South Wales and South Yorkshire, while the State proposals to encourage association in the British form of the German cartel for the stabilization of prices and the determination of quotas must improve enormously the financial and productive position of the industry. The position is more complex in textiles owing to the enormous number of producers and the diversity of products; but already two main groups can be distinguished in cotton-spinning, and, in time, they may dominate that side of production. In chemicals rationalization has advanced so far that the process might almost be regarded as complete.

In a short time, therefore, the entire industrial organization, as far as the great power-consuming industries are concerned, will be in a position to embark on large modernization schemes, where electricity should play a very large part. This period of revival and reorganization should coincide almost exactly with the completion of the main transmission system projected by the Central Electricity Board, and the latter should, therefore, be in a position to contribute towards rapid electrification of those industries. State assistance, as far as our knowledge of the position goes, would aim at acceleration of the process by which those industries would be able to improve their credit position. It would possibly take the form of a State guarantee for new capital raised for productive equipment, provided it could be proved that such new equipment would show reduced costs and so improve competitive efficiency that they would justify the new capital expenditure. It should not be difficult for those industries to make clear the case for such assistance after the movement towards rationalization and the stabilization of market conditions has come temporarily to an end.

Apart from the heavy industries which can be directly assisted by the State along the lines indicated, there is an immense number of smaller industries waiting to be tapped, provided some effort is made to survey possibilities in this direction, especially on the part of the supply undertakings, and a definitely educative campaign

THE CO-ORDINATION OF INDUSTRIAL DEVELOPMENT

be carried out. Firms within those industries are so small that the widespread adoption of hiring of equipment on the part of the undertaking might be considered. It is true that, in the progressive areas of Great Britain, the hiring of industrial motors by the supply undertakings has been considerably developed, but there is definitely room for a rapid expansion of this system, and the local authorities especially should be encouraged to finance such a policy more freely than in the past. They should be encouraged to do so by the Electricity Commission and the Government.

Before, however, rapid changes could take place in this direction, a survey should be carried out of the industrial power load and its potentialities within the area of supply. Such regional surveys have not been carried out to any great extent in this country outside of a few municipalities, but such surveys have been very widely elaborated in the United States. A fine example of what can be achieved in this direction is provided by the Detroit Edison Company, where, as a result of a very elaborate investigation, the undertaking was able to concentrate its sales campaigns on potentialities which had hitherto remained undisclosed and thus increase considerably the load on the system. As we have indicated in the previous chapter, there is still a very large field open in industry as a whole, but this field requires to be surveyed accurately in order to ensure that effort shall be properly directed and policy be exactly co-ordinated to the possible demand.

Again, some effort should be made to exploit more fully the surplus power possibilities of the coal-mining, iron and steel industries themselves. The reorganization of electricity supply in Germany, for example, has brought with it the interconnection of the public system and industrial plants for mutual assistance. In this way, the cost of electricity over a large area is reduced and the large power-consuming and producing industries are allowed to tap new sources of revenue. The most striking example of this system of mutual support outside of the Ruhr is to be found in Northern France, and there is no doubt that it has been a very important factor, making for the complete electrification of the coal-mines and for the installation of large new iron and steel plants. Such an adjustment should bring closer to realization the establishment of by-product installations to treat coal more effectively for by-products of commercial value before it is consumed under boilers in generating stations or in industrial plants. In all of these directions the industrial demand for electricity can be stimulated and the national standard of electrification be raised to the German or American level.

The electrical manufacturing industry, of course, is directly interested in such a movement, since it will supply the additional generating plant required in the power stations, and it will, in the majority of cases, furnish the equipment for the

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

power-consuming industries themselves. Electrical and allied firms can carry out without difficulty the complete installation of a new rolling mill, for example, or of a by-product recovery plant. The industry contributes, therefore, to improved national activity, firstly, through its ability to supply power-generating machinery, and, secondly, through the experience and capacity it places at the disposal of those who desire to carry out large industrial renovations and extensions.

The electrification of transport comes next in importance to industry and represents an even greater potential demand. Such a demand would be represented by electrification of the railways, main-line and suburban; the introduction of all-electric operation in ship propulsion through turbo-electric drive; the electrification of dock equipment for pumping, transport and conveyance, and the use of electrical machinery for communication purposes.

In railway electrification practically nothing has been done in this country outside of the Southern Railway system, which has carried out probably the greatest suburban electrification scheme in the world. There are isolated stretches of railway in the North-East Coast area and Lancashire, Wales, and in North London which are given over to electric traction, while one suburban stretch from Manchester to Altrincham is under construction. There is no reason why main-line electrification should not be undertaken. The main argument against it hitherto has been that the cost of electricity and the capital expenditure required per mile of track would be so high that conversion from steam drive would not be justified. It has been observed also that the location of existing public supply stations and the arrangement of transmission and distribution systems are not altogether favourable for supply to the railways. There would be the necessity for new power stations and new distribution systems to supply power for traction, and the capital cost of generation, transmission, and distribution would be added to the cost of electrifying the track and of providing rolling stock.

As a result of the completion of the national scheme, however, the whole position will be changed. The Central Board will be in a position to supply electricity direct to the railways from the main transmission systems and thus render unnecessary the construction of new power stations. The railways will incur alone expenditure on distribution and they will be able to obtain their electricity at a very low price. One important element in total capital expenditure as represented by generation would, therefore, disappear, and a new set of capital values enter into consideration. The capital cost of electrification would bear on conversion of the line, the provision of electric locomotives and motor coaches, and the supply of distribution cables with a number of sub-stations. The argument against conversion

THE ELECTRIFICATION OF MAIN-LINE RAILWAYS

based on capital expenditure will be considerably weakened by the national scheme itself, while the possibility of obtaining electricity at $\cdot 4d.$ or $\cdot 5d.$ per unit is such as to bring to British railway companies all the advantages of cheap power which Swiss, German, and French railways enjoy at the present time.

It is not necessary for main-line electrification that water-power stations should be present. Thus we find that, in Germany for example, steam-power stations perform almost as great a part as water-power stations in the provision of energy. In the United States the electrification of the Central Illinois lines has been carried out on a basis of agreement for power supply to be furnished by the Commonwealth Edison Company from its steam-power stations. In South Africa the very important main-line electrification from Glencoe to Pietermaritzburg is supplied from the Colenso station, which is a fairly efficient station by modern standards consuming coal. The electrification of the Great Indian Peninsula Railway provides for a steam-power station at Kalyan equipped with 40,000 kilowatts, with a final capacity of 80,000 kilowatts of turbo-alternators. In practically every country under consideration, and above all, in Germany, Switzerland, France, U.S.A., South Africa, and India, the cost of electricity as supplied to the railway sub-stations is actually higher than the cost at which the Central Board will be able to furnish energy in a few years' time.

If, therefore, load conditions, traffic density, and other conditions are not less favourable in this country than in any of the other countries mentioned—from many points of view they are more favourable—and if it has been proved to the satisfaction of the executives that main-line electrification in the United States, in Switzerland, and in Italy has justified itself economically—and very detailed reports exist to prove this—then there is no weighty reason why the introduction of a similar policy into Great Britain should not increase very considerably the profit-earning capacity of the railways and render them capable of performing a more efficient and more rapid national service.

Other countries have moved very rapidly indeed in the direction of main-line electrification. Thus Germany has now 1327 kilometres of track electrified, France more than 1250 kilometres, Italy 1251 kilometres, Switzerland 3340 kilometres, the United States 2880 kilometres, Austria 557 kilometres, Japan 540 kilometres, South Africa 275 kilometres, and Morocco 255 kilometres. There is in process, therefore, a steady movement towards conversion from steam to electric operation, and it is important to note that the countries with previous experience of the results of such electrification have embarked on very large schemes. The British electrical manufacturers have completed or are now engaged on railway electrification projects

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

in Brazil, Chile, Argentina, Spain, South Africa, India, Australia, Holland, Hungary, and Japan. There is no question, therefore, of the capacity of the industry to carry out in the most complete detail main-line electrification schemes in this country. Their experience is probably greater than that of manufacturers in any other country in the world, since they have been responsible for practically every electrification scheme carried out since the conclusion of the war, outside of the United States, Germany, France, Switzerland, Italy, and Scandinavia.

The case for electrification of suburban lines in densely populated areas has already been proved. The experience of the Southern Railway in London has already supplied sufficient data to show that, from every point of view, economic as well as technical, electrification has justified itself. In other countries progress in suburban electrification has been even more rapid than in main-line electrification, if allowance is made for the fact that in every country the densely populated areas located round one metropolis are comparatively few in number. The ideal in this country would be for the very large towns, like Birmingham, Manchester, Sheffield, Leeds, and Glasgow, to electrify their suburban systems and link up such systems by intermediate main-line sections. Some such system has been at work in the Southern Railway in connection with the proposed electrification of the main line to Brighton, and it has already played some part in the extension of electrification as far as Guildford south of the Thames and Windsor north of the Thames.

In other countries suburban electrification has been widely adopted. Thus Naples in Italy, Paris in France, Berlin and Hamburg in Germany, Prague in Czecho-Slovakia, Budapest in Hungary, Athens in Greece, Bombay and Madras in India, Cape Town in South Africa, New York in the United States, and Buenos Aires in South America have already embarked on very large schemes or are actually working under this system. In every one of these areas, with the exception of Naples, Berlin, Hamburg, and New York, the British manufacturer has been active in supplying equipment and in executing the work of conversion. There is now a very large volume of operating experience available for use in connection with any scheme which aims at suburban electrification, and in this direction very rapid progress could be achieved in this country, which would have full economic justification.

In marine transport the use of pulverized fuel combined with turbo-electric propulsion as well as Diesel-electric drive is spreading slowly but surely, and British electrical manufacturers have already equipped a number of ships from the turbines and engines to the most detailed electric fittings. It is clear that in this direction lies the greatest possibility of realizing the more efficient utilization of the

SOME POTENTIAL MARKETS FOR ELECTRICITY SUPPLY

mechanical and electrical engineering resources of this country. This observation applies with special force to new construction. Again, it is almost unnecessary at this stage to emphasize the importance of electrical equipment in dock traffic and cargo handling. The new docks constructed at Tilbury and Liverpool afford in themselves a fine illustration of what can be achieved in this direction.

All of these developments form part of the reorganization and improvement of transport and shipping facilities in this country. Such improvements contribute very greatly to the competitive efficiency of this country in overseas markets, reduce costs at home, and create a larger demand for industrial products. The electrification of suburban systems will improve the earning capacity of the railways themselves and render possible a reduction in the charges made for the transport of industrial products. Main-line electrification will accelerate shipments and allow delivery dates to be considerably shortened, while the improvement of cargo handling facilities must have its effect also on export possibilities. Electrification of transport and shipping represents one well-defined and well-connected series of improvements which will increase the national economic prosperity through its influence on industrial competitive efficiency.

A third important potential market for electricity, which has not yet been tapped, lies in agriculture. It is possible to consider agricultural electrification from two standpoints :

- (1) That of the existing economic configuration of the industry ;
- (2) That of its economic potentialities.

Two surveys of first-class importance have been published in the last two years—namely, one by the Electricity Commission¹ in July 1928, and one by the Institute for Research in Agricultural Engineering² at the University of Oxford in 1929. These surveys are largely complementary, and the greater part of them is devoted to an examination of the existing conditions of consumption in rural areas. Their estimates of the annual consumption of electricity by various types of farms do not entirely coincide. Thus, according to the Electricity Commission, an arable and stock farm of about 300 acres, including a farm-house with seven residents and two cottages with three residents each, would be responsible for an annual consumption of 10,350 units. A similar farm, as examined by the Oxford Institute, would show a consumption of about 9500 units per annum.

The Oxford survey divides the various types of farms, arable, stock, and dairy,

¹ *Electricity Commission : Report of Proceedings of Conference on Electricity Supply in Rural Areas.* 1928.

² *Institute for Research in Agricultural Engineering, University of Oxford : Electricity in Agriculture.* By C. A. Cameron Brown. 1929.

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

into nine groups, and for 945 farms actually examined a total consumption of 2,478,000 units could be established. This would give an average per farm of 2620 units, which must be regarded as erring on the low side. The types of farms covered extend from 50 to more than 300 acres. According to the report of the Electricity Commission, farms exceeding 50 acres number 263,000 in Great Britain, and, applying the Oxford average, one would have a total consumption of 690 million units, equivalent to an output of 830 million units per annum. To this total should be added that of consumption by rural townships, villages, isolated cottages and isolated residences, regarding which no reliable estimates could be made. One would assume, however, that the total consumption in rural areas, including farms, would be rather more than twice the estimate for farms alone, so that a reasonable estimate of consumption would lie in the vicinity of 1600 million units per annum, equivalent to a production of about 2,000,000,000 units.

Reservation must also be made for other forms of power employed in agriculture, which, economically, may have justified themselves more fully at the moment than electrical equipment. In 1925-26, all farms employed 80,010 fixed or portable engines and 18,372 motors and tractors, a total of 98,382, with an estimated aggregate power capacity of 500,000 H.P. to 600,000 H.P. In this total were comprised 65,881 oil or petrol engines.

The main point at issue is, then, this: Is the mechanical power used by agriculture sufficient for its purposes, and is the failure to electrify due to the high cost of electrification as compared with other power systems, or, again, are the farms insufficiently equipped both with mechanical and electrical power? The answer to this may only be found indirectly through comparison with other countries. Germany with 5,143,082 agricultural holdings and a total area of 105,000,000 acres—almost exactly three times the British area—employed, in 1925, 2,029,770 engines and machines for all purposes, with a capacity of 4,005,025 H.P. Of this output, electric motors represented 3,334,051 H.P., or 83.2 per cent. A comparative figure for Britain would be 1,330,000 H.P. (rather more than twice the existing estimate), with electric motors at 1,110,000 H.P. One should assume, first, that power of any kind is insufficient in British farms, and, second, that electrification has not even been introduced.

Perhaps the most interesting economic change that the extension of electricity to all parts of the country may bring is that of the decentralization of industry and, with it, the resuscitation of local industries dependent on a new form of rural craftsmanship. Such industries would depend entirely on the possibility of being able to obtain power at a low rate and install small electric motors for power purposes.

AGRICULTURE & DEVELOPMENT OF LOCAL INDUSTRIES

Activities in this direction would cover wood-working, leather-working; weaving, plaiting, and dyeing, not merely of textiles but of straw and similar agricultural products; pottery and porcelain manufacture, and an enormous range of what might be regarded as small applied art products.

Certain critics have questioned the possibility of establishing such local industries, basing their objection on the theory that there is no innate applied art instinct and that there is no real background of past achievement against which present activity might be measured and present standards of production assessed. The answer to this can be found in Germany and, above all, in Württemberg and the Black Forest. Those regions have undergone a marked industrial revival during the last four years and are now actually exporting a large volume of applied art and furniture products to Great Britain. There are whole areas engaged purely on work for the British market, and it has been freely stated there that the extension of such local activities has been due to the enterprise of the State supply undertakings, not only in providing electricity but also in hiring out the power equipment required in the small workshops. In addition to this, there are definite schools of design, which are calculated to create an art instinct and ensure appreciation of original and effective applied art forms. Success has been realized, therefore, through a combination of enlightened public policy, as shown in education, and a broad conception of its duties on the part of the electricity supply undertaking.

There is no reason why, in this country, exactly similar results could not be obtained, and the fact that German enterprise has already created a demand for rural applied art work should be in favour of a rapid expansion of those economic activities here. A new form of artistic education should be contemplated, not that of the preparation of pupils to meet the requirements of the large commercial organizations, but rather education in what might be termed local aesthetics, where local traditions and local colour may be used in a decorative sense.

Outside of such industries comes, of course, the industrialization of agriculture itself. Agriculture should be the centre of an entire range of activities using its products for wider industrial purposes. Such activities would cover the manufacture of cellulose with its finished products, the extraction of sugar from sugar-beet, the canning of fruits and certain vegetables, confectionery works, and even, in certain cases, chemical works. There is also the question of the preparation of the land itself for cultivation and the economic utilization of its potentialities through co-operative effort. In this case, there would be co-operation between individual farms and individual plants to ensure the pooling of local manufacturing and agricultural

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

resources. With such a system the task of linking up agricultural electrical development with the national scheme would be facilitated.

A remarkable example of what can really be achieved is provided by Italy. Owing to the enterprise of the present Italian Government, a very large territory bordering the River Po and in Venetia has been surveyed with a view to improving, through irrigation and through drainage, the fertility and the economic yield of a large portion of the Plains of Lombardy and Venetia. In this case, the pumping and irrigation plants have been interconnected through low-tension transmission lines, and they tap at certain central points the main transmission system stretching from the Alps to Central Italy. The result has been that the main transmission system has a higher profit-earning margin, the price of electricity is reduced, and both electricity supply and agriculture benefit. As part of this system have been included a whole series of local mills and a number of small factories. The result has been that the industrial and agricultural development of this large territory advances evenly and rapidly. According to a survey published by the Italian Association of Supply Companies, the actual horse-power of undertakings interconnected is in the vicinity of 70,000 H.P. scattered over 450,000 hectares. Similar developments could be carried out in this country when the national scheme will have reached a development commensurate with that already recorded in Italy, and it is probably through the introduction of such a system that the greatest advantage will be obtained from rural electrification.

In the previous chapter dealing with the demand for electricity, we adopted the American standards for an estimate of the potential consumption for domestic purposes, and we obtained a total figure of 3,400,000,000 units. This would correspond to a consumption of 2,800,000,000 units, almost exactly twice that recorded in 1926 for lighting and domestic purposes. This estimate covered possibilities during the next twelve years, but does not represent the final volume of consumption which might be expected under this heading. The domestic consumption of electricity depends above all on the state of prosperity in the country as a whole and on the purchasing power of the public. During a period of economic depression one would scarcely expect a large expenditure on electrical appliances which, while they add to the comfort of life and become in time necessities, represent a new form of consumption which enters partially into the luxury class.

Some clue to what might be expected may be found in the returns of income tax prepared by the Board of Inland Revenue. For the year of prosperity, 1919-20, a very complete survey was carried out of rates of income and the number of taxpayers classified under such rates. In that year, the total number of ratepayers with

PRESENT & FUTURE ANNUAL ELECTRICAL CONSUMPTION

incomes over £130 per annum was 7,800,000 and, above £200 per annum, 2,279,000. Allowance must of course be made, on the one hand, for the decline in purchasing power that has taken place since then ; but, on the other hand, this is partially balanced by the increase in population and by the consideration that, under normal conditions of industrial activity, a state of prosperity very similar to that ruling in 1919-20 should be possible. One can assume, therefore, that about 2,279,000 taxpayers represent a possible market for electrical appliance and for the consumption of electricity on a domestic basis.

The question arises : What would be a reasonable annual consumption from each taxpayer using electricity for all purposes ? Various experiments carried out during recent years into the consumption of electricity in an all-electric house and in an all-electric flat have shown that a fairly large all-electric house would consume annually about 16,000 units, while an all-electric flat would probably average about 7000 units. This, however, must be regarded as figures which are only possible for taxpayers with incomes in excess of £600-£700 per annum. For the country as a whole a maximum of 2500 units might be expected, and this, applied to the 2,279,000 ratepayers, would give about 5,700,000,000 units.

One should make allowance for the consumption for lighting purposes alone on the part of the remaining 5,521,000 taxpayers recorded, where an average of about 150 units per annum might be expected. This would give 830,000,000 units as an additional lighting figure ; but even in this class the use of the electric iron and, in some cases, of the vacuum cleaner might be expected, and a conservative estimate would establish consumption at about 1,500,000,000. The resultant total for all lighting and domestic purposes would establish consumption at about 7,200,000,000 units, equivalent to an output of 8,500,000,000 units from the generating stations. A very considerable period of years, however, would require to elapse before such a result could be achieved, and expenditure on developing such a load would be decidedly greater on the part of the supply undertaking than the acceleration of industrial or transport electrification.

A further possibility lies in the commercial demand for electricity. Such a commercial demand would be found in illumination of public buildings and the development of propaganda, especially in large cities, through illuminated signs and even illuminated architecture. It would also cover the large-scale introduction of electric heating into commercial buildings and blocks of flats, the widespread application of electric cooking in hotels and restaurants, and the use of electric refrigeration. It is impossible, under present conditions, to make any estimate other than that which we have already attempted in the previous chapter as a result of

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

observation of American conditions. It is possible, however, that the commercial demand may in time be even greater than the domestic.

One can see in the future an entire national economic and social organization based on electrical power. Large central stations interconnected by overhead main transmission lines will bring rivers of energy from one reservoir to another, electricity will be produced in enormous volume, the great power-consuming industries will feed their surplus into the national system and tap it, in turn, at certain periods when manufacturing activity causes an excess demand for motive power. The great industrial centres will maintain in constant production an intricate and highly elaborate world of factories and workshops, while small tradesmen and rural artificers will again be active in producing commodities of value and beauty sufficient to bring prosperity back again to country townships, rural districts, and isolated market towns. Suburban electrification will improve the transport difficulties in the densely populated areas, while the electrification of the main lines will accelerate the transport of industrial products and allow the manufacturer to carry out that ideal of service to the consumer which has always formed a part of the American gospel of prosperity. The household, as a result of improved economic conditions, will be changed and beautified through the use of electricity. One can see the entire national economic and social organization living and moving as part of a new and higher civilization brought into being by electricity, and the possibilities of realizing such a consummation gives a purpose and an energy to the power industries such as no other industry or group of industries in the past.

II.—ELECTRICAL MANUFACTURING EXPANSION

We have dealt with the possibility of expanding the national electrical power consumption, and it is through such development that the electrical manufacturing industry must expect to obtain the greater part of the increased demand which is necessary before it can reach what may be regarded as a generally representative position in national production. The electrical manufacturing industry is, in itself, highly organized; its factories are, on the whole, as well equipped as the finest factories of the United States or Germany, and it, as a rule, can obtain all the capital it requires for its own immediate purposes. Its credit is sufficiently good for it to obtain its capital requirements in the open market at a reasonable rate, so that it is not dependent on bank advances, bank loans, or other forms of credit to the same degree as the heavier industries. Its importance to the country as a whole lies, above all, in the employment it can give to other industries, and any effort it makes

EXPENSES OF ELECTRICAL SUPPLY UNDERTAKINGS

to increase its output from its own resources alone or with a certain measure of State encouragement (as shown by the national scheme) is translated at once into increased production on the part of the industries feeding into it. Electrical manufacture represents the concluding link in a long chain which reaches through every activity in the country; its raw materials are the finished materials of many industries; it gives employment to iron and steel firms in connection specially with the provision of steel castings, steel plate, steel forgings, dynamo sheet steel, and it benefits also the iron industry through its demand for pig-iron for use in the foundry. It also represents an important market for the textile, paint and varnish, glass, timber, non-ferrous metal working, and machine tool industries; it obtains from general engineering many allied products necessary to complete plant installations. In addition to this the power stations and railway electrification works on which its firms embark create a large demand for structural steel, bricks and cement for building construction. It is possible to elaborate still further, but one indication alone is significant: one large composite electrical firm counted among its main suppliers no less than one hundred and fifty industries. The point, therefore, should be emphasized at once that increase in electrical manufacturing production means a very considerable overall increase in the national industrial production.

Analysis of the total capital expenditure by public supply undertakings in this country shows that the purely electrical engineering section does not account for more than 65 per cent, the remaining 35 per cent being represented by buildings, civil engineering, and similar activities. Of this 65 per cent, materials alone, as supplied to electrical manufacturers, would account for 50 per cent at least, so that of this entire capital expenditure the part represented by direct manufacture in the electrical and allied workshops would not be more than 30 per cent to 35 per cent. To assume, therefore, that any increase in activity resulting from electrification would benefit electrical manufacturers alone is merely to be guilty of distortion. The benefit conferred on the national economic production, as a whole, by the electrical industry through increase in output is out of all proportion to the value of such output, and any policy aimed at expanding its activities would probably be more productive as a measure for decreasing unemployment than almost any other measure with a similar aim in view.

In one direction especially, electrical manufacturers can find greater immediate possibilities of increased output than in any other—namely, export trade. As we have already indicated, the electrical manufacturing industry has been able to develop a fairly strong export position, but it is not a position which bears any relation to potentialities even if the financial strength of this country had been

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

properly applied. It has not been able to make the fullest use of the financial resources in this country for power development overseas, and it has not been assisted by the system adopted in the London market of issuing new overseas capital without reference to the needs of British industry.

There is no doubt that the policy behind exporting financial institutions and issuing houses, in London, is purely one of security of capital and the possible return on it; there is no question of advantage, or otherwise, to British trade. New capital is offered to the public without conditions and without guarantees that a definite proportion of this is to be expended directly in this country. No discrimination between borrowers, on grounds other than those of security of capital, is made. The result is shown clearly in Table LXVII., which is in itself sufficient comment on the value of capital exports as conceived by London issuing houses to the British electrical industry. A comparison between £25,000,000 of capital sent overseas to finance contracts placed with competitors, and of no value to British industry, and £11,000,000 which benefit it is sufficiently remarkable. If we consider that two of the companies listed in the second half of the table—namely, The Hungarian Trans-Danubian Electrical Company and the Perak River Hydro-Electric Company—raised capital amounting to £6,748,000 with the partial assistance of the Trade Facilities Act, we find that the real comparison lies between £4,252,000 and £25,000,000; in other words, only 20 per cent of the new capital raised in the London market for electricity supply and allied activities benefited directly British manufacture. The theory is, of course, that such overseas capital comes back, sooner or later, to Great Britain; but in the case of the German loans the transaction was concluded by shipments of gold considerably in excess of the loans granted. Practically all of the new capital was required in connection with the installation of plant for the German national power scheme, a scheme destined to raise the competitive power of German industry and increase the difficulties of our own industries competing in overseas markets. Contracts placed with the manufacturers allowed them to increase their manufacturing load, reduce the costs of production, and quote prices below the minimum possible to British manufacturers.

Such issues not only bring no benefit to British industry but they constitute a premium on foreign competition. They are directly antagonistic to the best interests of British industry and the national economy as a whole. The new capital, amounting to £25,000,000, might have been available for electrical power potentialities in the Empire, in South America, and in Asia. As the second half of the table shows, it could even have been applied to Europe with success. The increase of exports, amounting to £10,000,000 per annum, resulting from the better selection

FINANCIAL POLICY AND POWER DEVELOPMENT

TABLE LXVII—FOREIGN CAPITAL ISSUES IN LONDON

1925-1929

A. Which have not Benefited British Manufacturers

Company.	Capital Raised.	Year of Issue.
Tokyo Electric Light Co.	£4,500,000	1928
City of Berlin	3,500,000	1927
Skoda Works	2,425,900	1926
Vorarlberg Illwerke A.G.	2,000,000	1929
City of Hamburg	2,000,000	1926
City of Munich	1,625,000	1928
City of Danzig	1,500,000	1925
City of Cologne	1,150,000	1928
Prussian Electricity	1,000,000	1928
City of Saarbrücken	1,000,000	1928
Port Alfred Pulp and Paper	1,000,000	1927
Quebec Power	800,000	1928
Free State of Saxony	750,000	1927
City of Dresden	600,000	1927
Société Intercommunale Belge	500,000	1928
Total	£24,950,000	—

B. Which have Benefited British Manufacturers

Company.	Capital Raised.	Year of Issue.
Perak River Hydro-Electric	£3,448,000	1926
Hungarian Trans-Danubian Electric	3,300,000	1928
Palestine Electric	900,000	1927-28
Adelaide Electric Supply	850,000	1924-28
Atlas Light and Power	530,000	1927
Nigerian Electric Supply	250,000	1928
Buenos Aires Lacroze Light and Power	450,000	1929
Melbourne Tramways	300,000	1927
East Africa Power and Lighting	300,000	1926
Auckland Electric Power Board	270,000	1927
Southern Brazil Electric	250,000	1926
Southern Brazil Electric	200,000	1927
Total	£11,048,000	—

of overseas investment in this case would have given employment to more than 60,000 workers, and would have improved so greatly the competitive efficiency of the exporting industries that they would have, probably, increased their hold on overseas markets. It is true, of course, that in each of these overseas issues the security was entirely adequate. It was represented either by a municipality, a state,

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

or a large international finance consortium ; whereas, in the second half of the table, the security was represented by the enterprise and ability on the executive in charge of the undertaking in question. The one case is an example of international finance operating without reference to the economic needs of any country and with a view to its own profits and its own security, and the second that of enterprising directorates intent on developing the industrial economy and power potentialities of new and partially developed areas. It should not be impossible for the financial resources of this country to be used for the encouragement and support of industrial enterprise even if such support means the reduction of loans to our competitors and to undertakings under their control which are already adequately financed. The table shows very clearly the change in character that has taken place in financial transactions as carried out by the city of London. Before the war, new capital was used to finance developments in new markets all over the world and this capital was employed in increasing economic wealth so that it would be of greatest value to British industry ; now it follows the lines of least resistance and maximum security, with no reference to British trade.

We have already discussed various aspects of power finance and its effect on electrical export trade and have emphasized, above all, the need for the successful extension of this principle wherever possible. The potential electrical development of the world is very much greater than the present state of consumption, but the main problem is to find exactly where potentialities can be translated most easily into realities, and where industrialization, which is necessary to the introduction of electrification on a large scale, can be carried out without overwhelming difficulty. There is need, therefore, for an exact survey not only of the power resources of Great Britain which can lend themselves to immediate exploitation, but also of areas in the Empire and in the less developed foreign countries—notably in South America, Asia, and Africa—which lend themselves to economic cultivation on the basis of power as available from resources within their control or disposal. Numerous isolated investigations have already been carried out, but they have been, on the whole, spasmodic and have not aimed at completion within the territory of survey. What is required now is an evaluation, as exact as possible, of resources and industrial potentialities which can really be brought into activity through the immediate employment of capital ; and such a survey must entail, of course, very great expenditure which may have no immediate return.

Power finance corporations have been active in this direction, since it is largely the condition of their existence that they should be able to discover and finance a project capable of affording a return of capital and of creating a demand for power

THE PROVISION OF CAPITAL FOR NEW DEVELOPMENTS

equipment. But under present conditions power finance must necessarily take the line of security and of immediate result ; it can only be speculative to a limited extent, and it is not strong enough, as a rule, to carry out a work of economic exploitation which will entail with it the location of new industries and the construction of manufacturing plants. The problem, therefore, covers a much wider field than that which the power finance can itself undertake.

It is at this point that State assistance would be of service—notably in the Empire ; the provision of capital, either directly or under guarantee, for development purposes in association with power finance schemes would serve to open up new markets and stimulate the demand for practically every product which the manufacturing industries of Great Britain export. The process is clear :

(1) The survey of power resources, with the exact indication of industrial potentialities in the areas possessing such resources. Such a survey might be financed by the Government itself in co-operation with Dominion governments and colonial administrations.

(2) The creation of a development fund for the provision of capital calculated to accelerate the economic development of new territories.

(3) In addition to such a capital fund, there should be an expansion of the principle of State guarantee as represented by the Trade Facilities Act for the use of power finance concerns and electrical manufacturers, so that they can open up more fully territories already partially developed but capable of much more rapid expansion under proper guidance and with the proper provision of new capital. The Trade Facilities Act employed in this fashion would lead to an immediate increase in British electrical exports, and ensure some form of British control over markets which at the present time are in danger of passing over to the United States.

Industry in this country has not been able to accumulate the reserves and financial resources which American industry, protected by high tariffs and with an enormous home-market, has been able to accumulate, and, without some form of State guarantee, it becomes difficult for the British manufacturer to make good this disadvantage. We have already shown that the financial resources of this country, as represented by new capital issues in the London market, are not being employed for the benefit of industry in this country but, in many cases, for the benefit of our competitors, so that, short of the introduction of a policy of compulsory selection in the provision of new capital, a wider provision of the Trade Facilities Act becomes necessary. This may serve to neutralize to some extent the policy adopted by issuing houses in London and make the export of capital from Great Britain an asset to British trade and not a liability.

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

The Trade Facilities Act should be extended to export as well as to home possibilities. It will attract new capital propositions of a very sound type, since, of course, the cost of raising capital under the Trade Facilities Act is decidedly less than under ordinary market conditions. The net capital available to the company after the expenses of flotation have been made is much greater and the contracts it brings with it cover in value a much higher percentage of the actual funds raised.

In these directions the activity of industry can be stimulated and to some extent its competitive efficiency improved. In view of the fact, however, that under present open market conditions the prices obtainable by the electrical industry are clearly insufficient to permit of large-scale experiments and research expenditure, and in view also of the fact that under conditions of technical change, which tend to become more and more revolutionary as time goes on, the need for such research and development work grows more and more urgent, the Government should contribute more fully to co-operative research as carried out for the whole industry. Such research benefits not merely electrical manufacturers and the supply industry but also the nation as a whole, since it increases the capacity of the industry to obtain a larger volume of contracts and keep in the front rank of international electrical development. If the electrical industry had been working in a constantly rising market with satisfactory profit margins, such a system would not be necessary, but the actual value of turnover in the engineering sections is not much greater now than it was in 1920 and the margins available for experiment are decidedly less.

In addition to this, some acceleration could be given to contracts for generating plant and equipment through the allocation of orders by supply undertakings in advance of their requirements and through more rapid approval of generating plant extensions on the part of the Electricity Commission. The programme for the next twelve years has already been drawn up by the Electricity Commission for the Central Electricity Board and there is no reason why this programme should not be advanced by two, or even more, years. We are convinced that the estimates of increase in electrical power production, on which this programme has been based, are conservative in the extreme, and that, without some such acceleration, there may be a genuine shortage of generating plant. It is better to have a temporary surplus, if by the accumulation of such a surplus, employment can be increased in this country and the competitive efficiency of the electrical industry improved.

We have given in this chapter the elements of a national power policy in the belief that the realization of such policy must be conducive to greater economic prosperity. We summarize below the essentials of a policy such as we have already discussed :

THE ESSENTIALS OF A NATIONAL POWER POLICY

1. Rationalization, which is essential to the revival of the basic industries, should be confirmed and consolidated through the legal recognition of the right of combination, provided such combination aims at stability of price on an economic level. Such stability is essential to any scheme of reorganization and modernization of equipment.
2. The basic industries should be encouraged to improve productive capacity and electrify equipment through the provision of capital at low rates with State guarantee. Germany provides an example of what can be done in this direction.
3. The national scheme should permit of direct participation of the great power consuming industries, such as coal-mining, iron, and steel, so that they can dispose of their surplus power and realize a higher earning surplus on their capital assets.
4. Regional surveys should be carried out by supply undertakings with the active assistance of the Central Board and of the Government, with a view to determining where and how electrification of industry can be effected.
5. Main-line electrification could be carried out as part of a transport re-organization system for the entire country and the capital required for it could be raised under the Trade Facilities Act.
6. The national transmission system should be tapped for the erection of low tension distribution lines in the rural districts. The cost of such lines should be met in part by the State or a form of subsidy should be given to supply undertakings, where it can be proved that the return from such a system will not be sufficient within a reasonable time for the service of capital. This method has been adopted with complete success in Italy and France and has been the principal factor making for rural and agricultural electrification.
7. Local industries centring round the revival of rural craftsmanship might be encouraged and staffed as a result of educative campaigns carried out by schools of local design and applied art.
8. The export trade of electrical manufacturers would be increased if some selective principle were adopted in the flotation of new capital issues in London for electricity supply purposes. We have shown that over the period 1925-29 £25,000,000 of new capital was raised in London which brought no benefit at all to British manufacturers and actually constituted a premium on foreign competition.
9. The Trade Facilities Act should be employed very fully for export work and it should be accompanied by the provision of special facilities for economic development in new markets, especially within the Empire. Such development would accompany a survey carried out into power resources and economic potentialities.

ENCOURAGEMENT AND EXTENSION OF ELECTRIFICATION

ties. This survey would be undertaken by the Government in association with the Dominions and colonial administrations.

10. The State provision for centralized research and experiment work is not sufficient, at the present time, for the needs of the electrical industries and should be increased. The manufacturer does not obtain sufficient profit margins to finance costly experiment to the same degree as American, and even German, manufacturers. Centralized research in a highly skilled industry, like electrical engineering, is essential to the realization of a strong competitive position overseas.

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

CHAPTER VII.—ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

IN the survey now concluded our concern has not been so much to discover inherent weakness in the organization and efficiency of the electrical industry and propose elaborate systems of reconstruction and reorganization as to trace as clearly and as accurately as possible those movements and those tendencies which have governed development and the process of adjustment to new economic values. A knowledge of such movements and such tendencies may be of greater value in deciding enterprise and promoting efficiency than the creation of a fixed theory, with every postulate and every premise complete, preliminary to imposing it on an industry. Industry is a living, dynamic body; it yields to undue strain, but reacts at once when that strain is removed, or gathers to itself new forces to combat or neutralize it; it is perpetually in a fury of adjustment, and the policy guiding its movements is one of compromise and not of rigid adherence to fixed economic values; its motives are empirical and not always capable of logical definition; nor does it fit easily into any preconceived framework of thought or any mould formed by science working in the abstract. When it ceases to be active in adjustment and strives to live within a narrow regime with no element of speculation it becomes dead and fades away into oblivion. The world of industry is one of powerful forces thrusting against each other or combining in groups to dominate one range of economic activity; it becomes steadily more complicated with the progress of invention, and the effort to remain alive is one whose strain makes always for improving organization and improving efficiency.

It is for this reason that logically perfect schemes of reorganization in British industry must, in our opinion, be viewed with a certain mistrust: rationalization, either in the German or American form, has no magic powers to revive an industrial concern where there is no enterprise in administration, no courage in manufacturing and selling practice; where management is not wisely conceived and wisely co-ordinated, where technical ingenuity and the capacity to keep abreast of scientific invention are not present. Adverse criticism combined with the advocacy of foreign models may, indeed, be a useful weapon in the hands of foreign competitors intent on proving that the strength has flown out of British industry and entered into their veins, and thus contribute to the realization of the very opposite of what is desired. If British industry had been so antiquated and inefficient as

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

certain publicists and economists have asserted, then British export trade in manufactured commodities would have declined to zero. There is no philanthropy in business : the British product does not penetrate into foreign markets for sentimental reasons but for reasons of intrinsic worth ; and the fact that, through a decade of unexampled difficulty, British industry should have maintained a strong export position, and thus helped to create a surplus in international balance of payments sufficient to meet a large part of the requirements of a population enjoying a standard of living higher than before the war, is sufficient evidence of vitality and of essential power.

Attention should be directed to those restrictions which national financial, fiscal, and social policy have imposed on industry and prevented it from functioning in a normal fashion. Modernization of productive capacity and rationalization of administration and manufacturing technique are no new elements in industrial policy ; they have been present ever since the beginning of the industrial revolution. While deprecating, therefore, the confident recommendation of imported panacea, one must resist even more decidedly the efforts made by those who would desire industry to conform to ancient theory and antiquated tradition. It is only necessary, among other things, to examine the arguments advanced by local authorities to justify their purchase of foreign plant and machinery and to appreciate the point of view represented by suspicious and adverse criticism of co-operation in industry expressed by local politicians and free-trade fanatics, to understand how powerful tradition and a threadbare economic catechism can still be in this country. There is room for a new conception of the functions and national significances of industry on the one hand and for better knowledge of the obstacles confronting the national expansion of production on the other before industry itself can embark on a successful policy of reorganization.

We have made those observations in the desire to suggest a background for the judgment of movements within industry and, above all, the electrical industry. Two changes of importance may perhaps be singled out for consideration as illustrating the process of economic adjustment that is taking place : (1) the definition and realization of the essential unity of industry, and (2) the new interpretation of competition. The growth of statistics and other forms of information bearing on industrial operations has served to make industries cognisant of broad movements within the national and even international economic complex, and to inform industrial executives of the part played by their concern within an industry and within the group of industries which decide the economic wealth of the country. With this has come, consciously or unconsciously, the sense of corporate movement, the

RATIONALIZATION : STANDARDIZATION : RESEARCH

sense of one unit operating beside other units and not necessarily in antagonism to them, and the more accurate assessment of the state of market demand. The abolition of the isolated unit working for its own benefit, alone in a sea of uncharted and largely unknown competition, has been accomplished partly by this development of essential economic information, partly by the expansion of better education on matters of industrial organization, even if such education has been forced on executives by the contemplation of the American and German achievement in international competitive markets, and partly by the technical conditions of production itself.

Standardization of materials, processes, specifications, and fundamental design data, the comparison of operating results and the interchange of information regarding research and development work, and the demand within the market itself, have all served to show that co-ordination in the economic sphere as much as in the technical is essential to trade prosperity. This has led undoubtedly to the rapid development of mergers, amalgamations, and trusts aiming at a national and in some extreme cases at an international monopoly. Rationalization has become synonymous in this sense with co-operation of industrial producing units to form one manufacturing complex, adequate in all its members.

The ideal position would be reached where one large trust would control the entire market in any country. This trust would be directed by far-seeing men aware of their public responsibilities; determined to keep their costs down to an absolute minimum and to eliminate waste in marketing and distribution, so that the selling price to the consumer would be an economic one and would be calculated to keep the demand continually alive; prepared to carry out very large development and research schemes, with a view to making a product or group of products as fine and as efficient as science can make them; prepared also to give full publicity to their accounts and avoid all financial transactions which are not accompanied by improvement or expansion in production, and to adhere definitely to the doctrine that labour remuneration should be as high as the economic conditions of the industry would permit. Such a trust does not exist and will probably never exist, owing to the enormous diversity of economic conditions governing the activities and prospects of industry.

One aspect is of special importance in this connection—namely, economic research. The time is past when an industrial executive can rely on reports presented to him by his own sales managers or district representatives, and, in the light of these reports, plan his policy for the future. Such an executive may know exactly conditions within his own narrow range, but he has no real criterion other than his own

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

experience for judging the accuracy and value of the reports submitted to him, and for determining his own position within the industry in which he was operating. He must now measure from time to time his progress within the industry and within the world industry, since he knows that successful export trade can only be based on accurate knowledge of what demand is available for his products. He also lays emphasis on a knowledge of fluctuations within demand, due to factors not directly connected with his own industry. In other words, he budgets not merely for the direct activities of his firm as such, but also for potentialities within the industry considered nationally and internationally. Vision is substituted for a form of industrial myopia.

One factor which has made conditions unsympathetic to the introduction of rationalization in this country has been the restricted purchasing power of the public. Such a condition has made the market less responsive to price reduction than might otherwise have been the case.

At one time one would have assumed with a fair degree of accuracy that a reduction in price would automatically bring with it increased turnover; but turnover depends in the last resort on the volume of purchasing power at the disposal of the public. If this purchasing power remains constant, then price reduction must lead inevitably to increased turnover and competition might find in this some justification; but, as a result of the policy of deflation that has been carried out in this country since 1920, the volume of purchasing power has actually been steadily reduced, and unemployment combined with unproductive taxation has served to neutralize almost entirely all price reductions that have taken place. There has been no increase in volume to correspond with the decrease in price, so that there has actually been a steady impoverishment of industry. Under those conditions, rationalization and the elimination of competition has not before it the incentive of greater profits so much as the preservation of the majority of our industries from bankruptcy. The threat of bankruptcy has been a most potent weapon in the hands of those intent on concentrating production in a limited number of firms.

In this country in many industries rationalization had been based on a policy of restriction of output to meet a declining demand rather than of improvement of productive capacity to meet a demand which might be stimulated and which might show in the future very real expansion.

The ideal apparently is that of direct co-operation between manufacturing firms, where the firms retain their individuality but come together for the purpose of realizing the aims already indicated as resulting from rationalization. In this case,

ECONOMIC LIMIT TO INDUSTRIAL CONSOLIDATIONS

however, the stabilization of market conditions is the most important issue—stabilization not merely of manufacturing conditions but also of prices and, in some cases, of outputs. The central organization in this case can carry out for the entire industry practically everything that the trust carries out for the complex under its control, and, inasmuch as it is more susceptible to changes in demand and even movements in public opinion, it is better suited to British economic conditions than any other form of industrial concentration.

As we have shown in the first chapter of this book, while the tendency within the electrical manufacturing industry is for the large composite works to emerge and grow ultimately into a large consolidation, there must be an economic limit to the size of such concerns, and the determination of such a limit is one of the nicest problems in research awaiting solution. That it can be solved is undoubted, but there are no data available in this country to guide investigation, so that American experience must be tapped for any signposts it can furnish.

As one American observer has stated :

“ The problem of co-ordination within a great combination is tremendously difficult. There are conflicting interests and personalities to be reconciled. The chief executive, who is the only person responsible for the whole enterprise, must give all his time to internal relations—to bankers, lawyers and the like—and is put to it to enlist the best services of the actual operating officials. These in turn no longer have the full authority they once had when the business was their own, and they assign the drudgery, the burdensome, tedious work, to subordinates with still less authority. Department heads and employees are more interested, perhaps, in how efficient they appear to be rather than in how efficient they really are. Expensive and complicated statistical controls must be set up at a central office to measure what, of necessity, often eludes measurement.”

The excessively complicated concern degenerates into a mass of intrigue with little internal cohesion and a serious loss of efficiency ; the lack of responsibility stifles enterprise and confuses judgment, with its consequences in waste of time, energy and capital. The unity of industry is now conceived in three stages : the concentration of production in economic, but not necessarily enormous, units ; the co-ordination of such units to form one industry with a central production, selling, and market development policy ; and the association of industries for mutual assistance in matters of national significance. This last stage has yet to come, but it is a stage in which the electrical manufacturing industry is vitally concerned, since it furnishes equipment to all other industries.

In electricity supply which forms a natural monopoly we have shown that the most successful example of co-ordination on a national basis has been that of the

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

national power scheme, but even here the ideal has not been altogether realized. One leading American industrialist stresses the need of

“ a central directing organisation for the development and use of every power source in the country, tied into one national system for the service of the whole country—that is, welded into one operating and business unit. It has got to come, as the one necessary and economic method of power production.”

We have quoted from American opinion largely because the United States have moved much more rapidly in the direction of industrial and power mergers than we have in this country and, in that country, the value or otherwise of power trusts has been fiercely debated during the last three years. Even now the question is not solved. A leading article in the *Saturday Evening Post* of October 26, 1929, illustrates the American public attitude :

“ The power industry has been developing so rapidly and on such an enormous scale that all discussion concerning it is enveloped in a mist of confusion and doubt. There has been so much action that cool thought and analysis have lagged far behind.

“ On one point there is substantial agreement—namely, that in a single community there is no economy in having more than one company supplying light and power. Once this principle is established, there seems no reason why it should not apply to, say, a county, to a whole state, or even to a distinct industrial or geographical region. Thus the word ‘ trust,’ or ‘ monopoly,’ is largely a misnomer, or at least a superfluity, because the natural monopolistic character of the industry is conceded from the start. But the monopoly is far from a complete one, at that. Any consumer can build his own plant, provided he does not sell current to others, and defy the power company. In fact, any number of large industries do generate their own current. If they do not possess water power, they are at liberty to use coal, oil or gas.

“ The power end of the electric-light-and-power industry is becoming relatively far more important than the lighting end. In the future the electrification of railroads will loom large, and if the power companies do not offer attractive rates the railroads will manufacture their own juice. Formerly the so-called utility industry included street railways, domestic water-supply companies and gas lighting and heating as well as electric units, but now the tendency is for each of these different lines to go its own way. If there is monopoly, it is less to the extent of this tendency.”

This quotation brings us to the second development—namely, the new interpretation of competition. At first glance, competition admits of easy definition—it is merely the struggle to obtain the market or a considerable portion of the market in any commodity through quotation of the lowest price consonant with the maintenance of the minimum permissible standard of design and performance and materials. The firm, therefore, with the lowest costs would be the most successful. This simple definition requires modification to cover a number of very difficult complications. Can standards of performance and design be brought effectively into correlation with price and a capital value be assigned to quality, where such quality

NATIONAL AND INTERNATIONAL COMPETITION

is present? Can prices afford any indication at all of competitive value—especially in the provision of capital goods such as generating plant and equipment? The effect of technical progress in the electrical industry is such that the most complex calculations, based on accurate specifications and on a keen knowledge of the line of technical advance, must precede the examination of tenders and the allocation of contracts. In electrical equipment especially the consulting engineer or the technical authority in charge tends to become more and more important, and his recommendations are accepted by boards of directors or electricity committees with little discussion. It is not sufficient for a governing body to compare tender prices and select the lowest—the lowest may well be ultimately the most expensive of all. This observation is the more pertinent when foreign firms are tendering at excessively low prices in this country. It has been found that no real economies have been obtained in power supply in this country through the use of foreign plant, and that the most successful undertakings have been those which have been prepared to pay for quality and efficiency as factors in the contract prices. This has meant invariably the purchase of British plant. Again, the market is never entirely free in any overseas country; it is either protected by a tariff or partially dominated by financial groups or both, so that true competitive conditions do not exist: international or national agreements may link up producer and consumer or producer and producer; state aid or the direct encouragement of financial institutions may be granted to manufacturers to develop exports, improve employment, and strengthen the national balance of payments. The technical conditions of production may make for the elimination of competition: if materials, processes, fundamental design data are standardized throughout an industry, then it is inevitable that standardization in manufacturing processes and in factory costs must result, and with them standardization in price.

If it is agreed that standardization is necessary to efficient and high-quality production; if it is also agreed that tender specifications should be uniform for the purchase of materials and equipment, since without such uniformity no estimates of capital expenditure could ever be drawn up with accuracy, then the incidence of one price as quoted by many producers is not in itself an indication of concerted action by a group to hold up prices so much as the results of the effort to stabilize manufacturing conditions and quote a genuinely representative price. There is room here for close co-operation between producer and consumer in the determination of a reasonable price level. The system at present in operation in some undertakings in the country—namely, that of inviting quotations from a number of manufacturers from foreign countries as well as this country and then averaging the British price

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

down to the lowest foreign price quoted—is not calculated to obtain the best results either in equipment or service, while it leads to an enormous waste in tendering.

The new interpretation of competition is something decidedly more rational and scientific—it is that of an industry as a whole considered as a unity working to meet the requirements of the market with the maximum economy and speed and in competition with other industries. The productive capacity and factory costs of an entire industry come into consideration, and the provision of data bearing on such factors forms the basis of the agreement between producer and consumer. The system operates with complete success in Germany and the United States, and has been responsible to some extent for the rapidity with which electrification has spread in those countries; it has also been a powerful weapon in the hands of the electricity-supply industry in its competition with other industries. The tendency is for competition between industries to become more important than competition between individual firms. As the American authority already quoted states:

“The law of substitution serves as a natural check upon considerable potential monopoly. There are, it is true, a few articles for which no substitutes exist, and patents or control of limited natural resources may give monopoly in these cases. At one time it was thought that the few companies which produced anthracite coal had a monopoly. But the public found that it could use soft coal where once hard coal reigned supreme, and then oil came into wide use for the same purpose. To some extent also gas and electricity began to replace anthracite, and what seemed like a natural monopoly has been reduced to a competitive basis.

“Even the railroads, which appeared to have a natural monopoly twenty years ago, now find the most urgent competition in the automobile. Gas and electricity have largely supplanted kerosene, which once reigned alone. Glucose is used in place of sugar to some extent, silk in place of cotton and wool, and rayon in place of silk. In highway construction there is healthy rivalry between concrete and tar-covered surfaces. In building there are numerous substitutes—steel, concrete, brick and lumber. There are many kinds of lumber competing one with the other, and now even synthetic boards compete with the natural article.

“Business men and economists alike agree that competition between industries is of increasing importance. . . . We speak of this as the new competition, although it is more the emphasis than the thing itself which is new. But the point is that competition with another industry may be of more decisive importance as regards the success of a given enterprise than competition with another enterprise in the same line.”

The issues are no longer quite so simple as those in search of the lowest international prices for industrial products would have them; they have grown with modern industrial civilization out of the narrow nineteenth-century frames and are mingled now in that vast complexity which is the national industrial and economic organization. The conception of an industry working in cooperation with allied industries to advance the national productive status is one which rises above the

POSITION OF POWER INDUSTRIES IN NATIONAL ECONOMY

prejudices of tradition and outworn theory and bears in itself the one hope of continual and fruitful progress. At this point one arrives naturally at the question, "What then can be the future economic alignment of the power industries?"

It is already sufficiently clear that the power industries are destined to become the most important elements in the national economy of the world. The main motive force in industrial production is now electricity, and reorganization is fast becoming synonymous with electrification of manufacturing processes, concentration of output on highly electrified plants, and the better regional distribution of economic activity as a whole. In earlier years the geographical location of industry was determined by reference to fuel and power supplies. Mechanical energy could only be created and used in proximity to fuel, since it depended wholly on steam as generated from the combustion of coal in steam-raising plants, and it was cheaper to transport finished products to the centre of home consumption and overseas shipment than to transport coal. The industrial areas of Great Britain became territorially well defined and attracted to themselves human and material resources; they tended more and more to specialize in certain branches of production and allowed the smaller industries to dwindle and ultimately disappear. Productive capacity increased beyond a safe limit in the special industries, and imports took the place of production from smaller local industries.

With the advent of large-scale electrical power stations capable of transmitting energy hundreds of miles without serious loss, and housing in themselves sufficient power capacity to drive entire industries without difficulty, the position has changed. The overhead main transmission line has evened out manufacturing potentialities and thrown emphasis on factors governing directly production costs, competitive efficiency, and volume of demand without reference to fuel and power costs alone. A new industry is at liberty to choose its location purely with such items in mind as transport, distribution, taxation, and labour supplies, and the results of this position are already evident. With this has come also a nation-wide recrudescence of industrial activity, not measured in large units but in a complex of innumerable small units supplied from the national power system. Transport will, in time, be electrified both on railway and canal and furnish a cheaper and more rapid service than now. The basic industries, such as coal-mining, iron and steel, and chemicals, will exchange energy with power-producing authorities and be encouraged to study even more closely than at present the advantages to be derived from heat economy; coal-mining may be encouraged to embark more completely on a policy of development calculated to change its position to that of a finishing industry; agriculture may find it more profitable to exploit more fully its potentialities as a highly skilled

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

section of national activity, and to develop, through co-operation of producers, manufacturing organizations working up raw materials into products of a higher value. We are coming therefore more and more swiftly to the conception of a national industrial and power unity bound together through electrification, and it must be such as to raise the material prosperity of the country to a high level.

A heavy responsibility will lie on the power industries, and above all on those responsible for the operation of the national scheme. The Central Electricity Board has undoubtedly a higher function than that of the wholesale production and transmission of energy. Through its control of power production it can follow day by day the fluctuations in the national economy, since, with the almost complete electrification of manufacturing process, power becomes the most accurate index of activity. It can also trace movements of expansion and decline and design a chart of relative power densities in the country showing the fluctuations in industrial activity. Its first function in time may be that of improving load factors on power plants, but its later and more important functions will be undoubtedly to even out gaps in the national industrial organization, either through the active encouragement of new industries or through the provision of information which will guide those capable of initiating developments in economic activity. The power industries, welded together in a national system, have in themselves the greatest promise of industrial revival in Great Britain, provided their policy is wisely and broadly conceived, and provided that they work in co-operation with the electrical manufacturing organizations.

In such co-operation they can be instrumental in accelerating the national electrical development and in eliminating waste of time, energy, materials, and labour; they can be mutually helpful in a survey of potentialities and elaboration of the method by which the latter can be translated into reality. In isolation they cannot achieve the same measure of national service. Electricity supply, with a total capital expenditure in twelve years hence of about £650,000,000 and an output of 28,000,000,000 units valued at £120,000,000 (on an average of about 1.2d. per unit sold), will come second to the railways as the leading industry in Great Britain. Already in possession of a monopoly, it will enjoy all the advantages of co-ordination on a national scale through the Central Electricity Board.

Is it possible for the electrical manufacturing industry (which may reach in the same period an output of £120,000,000 to £150,000,000 per annum, with a capital investment of £130,000,000 to £140,000,000 and a labour force of 350,000 to 400,000) to reflect such a work of co-ordination and guide its development in the light of a national policy formulated by a central organization? The problem in

THE POWER INDUSTRIES AND INDUSTRIAL REVIVAL

this case is difficult owing to the necessity for the industry to export a large percentage of its output and owing to the enormous diversity of manufactured product, but there is no reason why, in the branches devoted to the provision of generating plant and equipment both for public supply and the large industrial concern, national co-ordination through a central association could not be achieved. With the supply and manufacturing industries held together on a national development policy, the future of electricity as a great moulding force in our industrial civilization would be sure.

There is a higher motive at work than the desire to accumulate profits and widen margins. It has a contact with the words expressed by an American industrialist at the opening of the Columbia power station in America :

“ The great power station opened to-day will produce energy equivalent to the work of nine million men. There is a population of one million in the service area of the Columbia Gas and Electric Company. This means, on the average, that nine additional slaves have this day been dedicated to the service of each man, woman, and child in this community. In Athens each free citizen had but four. This is the way that America must solve her problem of maintaining higher wages than any other country of the world and at the same time keeping her goods competitive in foreign markets. We must put more energy back of the worker, in order that he may be a director of power rather than a generator of it. . . . I want to see all this art not only run the giant industries of the cities, but I want it also to be so humble and true in its social service that we shall banish from the farmers' homes the drudgery that in the earlier days killed their wives. We have come here to dedicate a power plant—an instrument of utility. Is it only that? Perhaps it is a temple.”

One could substitute for Columbia—Barton, Barking, Hams Hall, Portishead, or any other of those great new stations which are now engaged in supplying power to wide areas of economic activity and apply the image and the lesson to Britain as well as to America.

The national power scheme, with its magnificent generating plants and its wide-sweeping transmission lines, will be a monument not merely to the enterprise and the faith of a nation, but to the ability and knowledge of those who have designed and equipped them. A strong electrical manufacturing industry is necessary to a strong power industry and to a strong national productive organization ; it furnishes the power-producing agents at the one end and the power-consuming machinery at the other ; its function is twofold and its achievement threefold. It contributes to efficiency in power generation as well as to efficiency in industrial production and, through its capacity to engage in export trade, to the strengthening of the financial structure of the country.

The advance which will take place in both electricity supply and electrical

ECONOMIC ALIGNMENT OF THE POWER INDUSTRIES

manufacture should, if co-operation is carried out successfully both on a technical and economic basis, be steady and characterized by few periods of mal-adjustment. We have shown that, as a result of the national scheme, the efficiency of the electricity supply industry will be very considerably improved during the next ten years, but such an improvement must represent, in part at least, the contribution of the electrical manufacturing industry. It will be responsible for the construction and equipment of new generating stations as well as the erection of main transmission and distribution systems. The question may well arise regarding the capacity of the industry to carry out this work effectively and economically. It has been, above all, the purpose of this survey to show that the industry is efficient in spite of obstacles placed in front of its natural expansion; that, measured by the standards available, it can take its place among the leading industries of this country and bear comparison easily with the United States and Germany in the technique of production, in the equipment of its factories, and in its administrative capacity. It has carried out power schemes, industrial electrification projects, and railway electrification plans of an importance second to no other in the world. There is no question, therefore, of capacity or of efficiency, but of the ability to make use of the resources available in the British electrical manufacturing industry for the exploitation of power resources, the successful realization of national electrification and the expansion of participation in world trade.

APPENDIX A—POWER FINANCE AND IMPERIAL
PREFERENCE
THE EXAMPLE OF CANADA

APPENDIX A—POWER FINANCE AND IMPERIAL PREFERENCE

THE EXAMPLE OF CANADA

IT has long been evident that the development of home and export trade is now dependent to a greater extent than previously on careful forecasting of tendencies and large economic movements. The course of industrial production and trade, which at one time was dominated by purely empirical adjustments to changes in demand and in price, is now being subjected to a more rational and more scientific procedure. It has been recognized that an industrial executive should be in a position to estimate with a fair degree of accuracy not merely the value of the market open to him at any time, but to assess also at their proper value changes in technique, in finance, and in marketing methods generally, which affect competition and the allocation of important contracts.

To give an example of economic research as applied to one market is difficult, owing to the fact that no market can be isolated, but in continuation of our study of export trade developments we have selected Canada as an object of study, not merely with a view to determining its value for the British electrical manufacturer, but also to discover those fundamental factors which govern the destination and distribution of the Canadian demand for electrical equipment.

Formerly one would have confined one's efforts to a careful examination of Canadian imports and exports from the main competing countries over a period of years, with the close determination of the competitive efficiency of each country as based on these returns. The assumption in this case would be that all countries started on equal terms, and that their share of the market would depend on such things as prices, design, and operating efficiency. In the case of Great Britain, one would assume that Imperial Preference and psychological elements of this nature would tend to weight the balance in favour of Britain, providing the factors already mentioned were also satisfactory.

An examination of conditions in Canada shows that this assumption cannot be held for one moment. As far as heavy generating plant and large contracts are concerned, the question of prices and of efficiency, and, with it, of Imperial Preference, has disappeared entirely into the background. The deciding factors in the Canadian demand for electrical goods are :

- (1) The deliberate support and encouragement of home production.
- (2) The growth of power finance.
- (3) The development of mergers and associations of power companies.

POWER FINANCE AND IMPERIAL PREFERENCE: CANADA

Market research as applied to Canada would cover these three points and practically no others.

It is inevitable that home production should be encouraged at all costs, since it is a universal tendency whose importance cannot be ignored. Examination of a number of representative prices shows that the Canadian supply undertaking does pay a much higher price per unit of plant supplied by the home manufacturer than he would pay to a British exporter. The policy of public utilities in the Dominion, and of the Dominion itself, has been to encourage the Canadian electrical industry wherever possible.

The British exporter could have little serious objection to this if he were satisfied in his own mind that the Canadian electrical industry were a genuine Canadian growth, but the greater part of Canadian electrical production is in the hands of subsidiaries of American firms, and there is no guarantee that the manufactured product as delivered by these subsidiaries has been entirely produced in Canada. Their plants may be purely assembly shops to carry out one single final operation prior to marketing the product. In any case, the materials used by such firms would come very largely from the United States. It is difficult, therefore, to believe that the support of home production, as carried out in this sense, is other than support of American production, while the profits derived from operations in the Dominion would go to American parent firms and American stockholders.

If an analysis is made of the detailed figures of electrical manufacturing production in Canada, it is found that the most important items in such production are insulated wires and cables, telephonic and telegraphic material, A.C. generators, transformers, lamps, and batteries. The production of A.C. generators alone amounts to about 8 per cent of the total of all products, so that the Canadian electrical industry has concentrated more fully on small apparatus requiring a low initial capital expenditure. Even in motors its production is almost exactly equivalent to the total imports.

As Table I. shows, home production of purely electrical products covers about 83 per cent of the market requirements, the remaining 17 per cent being met by imports from the United States and Great Britain. Allied products, such as steam and water turbines, condensers, and other mechanical auxiliaries, must be taken into account, but no reliable particulars are available regarding production which would allow us to construct a table similar to that given. It may be assumed, however, that imports from abroad constitute a much higher percentage of the market demand than in the case of electrical products. Canada is less self-contained in heavy generating plant and motors than in smaller apparatus, as we have already

THE CANADIAN MARKET FOR ELECTRICAL GOODS

TABLE I—PRODUCTION AND CONSUMPTION OF ELECTRICAL MACHINERY
AND APPARATUS IN CANADA

1920-1928

Year.	Production (Dollars).	Imports (Dollars).	Exports (Dollars).	Surplus of Imports (Dollars).	Consumption (Dollars).
1920	55,965,896	15,790,354	424,471	15,365,883	71,331,779
1921	45,093,591	17,182,859	651,461	16,531,398	61,624,989
1922	41,208,368	11,224,429	485,321	10,739,108	51,947,476
1923	51,360,400	12,109,775	1,199,427	10,910,348	62,270,748
1924	56,490,465	13,976,635	1,883,710	12,092,925	68,583,390
1925	60,158,837	14,288,871	1,609,427	12,679,444	72,838,281
1926	69,767,000	16,016,003	1,432,158	14,583,845	84,350,845
1927	78,000,000*	16,932,193	1,727,303	15,204,890	93,204,890

* Estimated.

THE CANADIAN MARKET FOR ELECTRICAL MACHINERY AND APPARATUS

1920-1928

Year.	Total Value of Market (Dollars).	Percentage covered by			
		Home Production.	Imports from U.S.A.	Great Britain.	All other Countries.
1920	71,331,779	78.0	—	—	—
1921	61,624,989	72.0	—	—	—
1922	51,947,476	78.5	15.7	1.4	4.4
1923	62,270,748	80.6	16.7	1.6	1.1
1924	68,583,390	79.8	17.9	1.4	0.9
1925	72,836,281	80.3	17.2	1.5	1.0
1926	84,350,845	82.7	14.6	1.8	0.9
1927	93,204,890*	83.5	14.1	1.6	0.8

* Estimated.

indicated, and as exports from Great Britain tend to be greater in heavy plant and apparatus, the competitive margin available is greater than the percentages indicate. This consideration is important in view of what follows.

On the evidence of the table itself, the British position in Canada is so bad that it might appear sound policy to abandon it as a market altogether. The percentage of the total trade done by this country is probably as low as that obtained in any other market in the world to which Britain exports electrical goods. Relatively and absolutely, the Canadian import figures from Britain are highly unsatisfactory, but this does not mean that the market should be abandoned as hopeless altogether. As a matter of fact, since 1924 there has been a very slow upward movement in the percentage supplied by this country, and even the present figure may be regarded

POWER FINANCE AND IMPERIAL PREFERENCE: CANADA

is remarkably high in view of the enormous obstacles placed in front of British trade. These obstacles are to be found, above all, in the development of power finance.

The significance of power finance as a factor in the development of export trade has already been discussed. In the hands of American groups it can be the deciding factor in the development of competition, notably in Canadian and South American markets. If the principal supply undertakings are in the hands of American groups, it is clear that the British exporter can hope for no orders from them, and the trend of American policy has been to secure such control. Side by side with such American groups in Canada have operated two main interests—that represented by the Holt-Gundy and allied groups in the first place, and that by Nesbitt-Thomson and allied groups in the second. The latter groups are Canadian in origin, but the former have affiliations with the Canadian subsidiaries of one large American manufacturing firm, so that one would expect power contracts to be allotted by its control companies either to the United States or to the Canadian subsidiaries of American manufacturing firms. This has undoubtedly been the case.

The result is that the purely Canadian market is represented by companies controlled by the Nesbitt-Thomson combination, independent companies, and the municipalities. In these three lies the possibility of developing British electrical export trade to Canada.

Tables III, XI, give some conception of the control exerted by the various groups in the Canadian power market, while Table II, indicates the distribution of orders as placed by these interests for a large percentage of the total generating plant capacity within their control.

Attention has been limited to water and steam turbines and A.C. and D.C. generators. The power plants covered represented rather more than 97 per cent of the installations in Canada, so that the picture given is practically complete. American-controlled companies are responsible for about 31 per cent of the plant installed and 32 per cent of the electricity produced, the Holt-Gundy group for 21 per cent and 24 per cent respectively, the Nesbitt-Thomson group for 14 per cent and 11 per cent respectively, leaving to independent companies and municipalities 33 per cent of the plant and of electricity production.

These statistics show exactly how strong is the hold on the market exerted by powerful finance groups, the only undertakings outside of their range of activities being the Hydro-Electric Power Commission of Ontario, the West Kootenay Power Company, and Winnipeg Municipality. Manufacturers associated even with one of these groups could depend on a large volume of trade which would not be subject to competition from outside firms, and we find that one firm more than any

SUCCESS OF AMERICAN POWER FINANCE METHODS

TABLE II—ELECTRICITY SUPPLY IN CANADA

I. Water and Steam Turbines

Group.	Total Capacity of Plant Installed.	Supplied by Manufacturing Firms in					
		Canada.	U.S.A.	Great Britain.	Germany.	Sweden.	Switzerland.
	(H.P.)						
American-controlled companies . . .	1,395,295	522,570	773,040	—	50,570	18,365	30,750
Holt-Gundy group .	944,429	324,879	606,050	—	—	4,500	9,000
Nesbitt-Thomson group . . .	639,110	275,180	229,300	19,900	45,830	7,900	61,000
Independent . . .	1,329,494	528,154	607,840	—	156,200	21,600	15,700
Municipalities . .	218,758	76,049	51,115	38,034	—	33,160	20,400
Total . . .	4,527,086	1,726,832	2,267,345	57,934	252,600	85,525	136,850
<i>II. A.C. and D.C. Generators</i>							
	(KVA.)						
American-controlled companies . . .	1,116,651	998,535	114,300	1,641	—	2,175	—
Holt-Gundy group .	789,887	387,635	397,602	4,650	—	—	—
Nesbitt-Thomson group . . .	523,929	323,894	97,172	49,688	—	53,175	—
Independent . . .	1,046,113	887,275	116,335	4,036	—	38,467	—
Municipalities . .	183,790	72,315	29,205	40,125	—	42,145	—
Total . . .	3,660,370	2,669,654	754,614	100,140	—	135,962	—

other has benefited, for example, from the activities of the Holt-Gundy and allied groups. The combination of American manufacturers with Canadian subsidiaries and allied companies has been all-important for the distribution of generating plant contracts.

If we examine each group in turn, we may be able to define more clearly the policy pursued. Thus in turbines American-controlled undertakings placed 37·4 per cent of their contracts in Canada, 55·4 per cent in the United States, nothing in Great Britain, and 7·2 per cent in Germany, Sweden, and Switzerland; in generators they supported Canadian production to the extent of 89·5 per cent, placed 9·7 per cent in the United States, and the remaining 0·8 per cent in Britain and Sweden. Thus, for the combined turbo-generator plant, assuming equal values for turbines and generators, Canadian firms supplied about 63 per cent and American about 32 per cent, foreign firms accounting for about 5 per cent. The Holt-Gundy group was more determined still in its support of American production. In turbines it gave 34·4 per cent to Canadian firms, 64 per cent to American, nothing to British,

POWER FINANCE AND IMPERIAL PREFERENCE : CANADA

and 1.6 per cent to Swedish and Swiss firms. In generators it allotted 49 per cent to Canadian, 50.5 per cent to American, and 0.5 per cent to British firms. For the combined plant Canada supplied 42 per cent, U.S.A. 57 per cent, Great Britain 0.25 per cent, and other countries about 0.75 per cent. There could be no doubt in this case regarding the preferences exerted by this group.

The Nesbitt-Thomson combination was decidedly more national in its distribution of contracts ; in turbines Canada received 43 per cent, U.S.A. 36 per cent, Great Britain 3 per cent, and other countries 18 per cent ; in generators the Canadian percentage stood at 62 per cent, the American at 18.5 per cent, the British at 9.5 per cent, and the Swedish at 10 per cent. In the combined plant Canada came first with 53 per cent, U.S.A. second with 27 per cent, Britain third with 6 per cent, and other countries accounted for 14 per cent.

The independents, largely represented by the Hydro-Electric Power Commission of Ontario, were more catholic still in their preferences. Thus Canada supplied only 40 per cent of turbines, U.S.A. 45 per cent, Great Britain nothing, Germany 12 per cent, and other countries 3 per cent ; while in generators the position was quite different, Canada supplying 85 per cent, U.S.A. 11 per cent, Great Britain 0.4 per cent, and Sweden 3.6 per cent. Canada supplied 62 per cent of the combined plant, U.S.A. 28 per cent, Great Britain 0.2 per cent, Germany 6 per cent, and other countries 3.8 per cent. The only undertakings in Canada to support the idea of Imperial trade to any extent were the Municipalities, who placed 17.5 per cent of their turbine orders and 21.8 per cent of their generators in Great Britain, against 35 per cent and 40 per cent respectively allotted to Canadian firms, and 23 per cent and 16 per cent respectively to U.S.A. For the combined plant, the British proportion was 20 per cent, the Canadian 38 per cent, and the American 20 per cent, leaving 22 per cent for Sweden and Switzerland.

Taking all the groups altogether, the British percentage for turbines, almost entirely steam turbines, has been 1.28. The capacity of all British turbines supplied to Canada since 1923 has been 100,000 H.P., and allowing for this, one can bring the proportion up to 2.2 per cent. In generators the British share was slightly higher at 3.26 per cent, allowing for orders placed this year, giving for the combined turbines and generators 2.7 per cent. This figure agrees fairly closely with that given in the table for all electrical products, and shows that the division of Canadian trade possibilities into the five groups already discussed is sound.

Without greater support from those groups, either as a result of direct financial penetration, or through a change in their policy, or through closer adherence to the idea of Imperial support, it is difficult to see how this improvement can be achieved.

THE AMERICAN CONTROLLED GROUPS IN CANADA

TABLE III—ELECTRICITY SUPPLY IN CANADA

AMERICAN-CONTROLLED COMPANIES. I. Capitalization (December 31, 1927)

Company.	Main Subsidiaries in Canada.	Common Stock (Number of Shares).	Preferred (Dollars).	Bonds and Debentures (Dollars).	Gross Earnings (Dollars).		Net Earnings (Dollars).		Form of Control.
					1927.	1928.	1927.	1928.	
Duke-Price Power Co.	—	210,000 (N.P.V.)	—	37,000,000	3,123,526	3,814,064	2,653,056	3,283,219	Aluminium Co. of America.
	1. Saguenay Electric Co.	7,500 (100 dols.)	700,000	1,360,000	—	—	120,000	—	—
	2. Saguenay Transmission Co.	—	—	—	—	—	—	—	—
International Power and Paper Company.	—	4,500,000 (N.P.V.)	97,933,600	—	Holding Company.				American Stock Ownership.
	1. International Paper Co.	1,000,000	97,933,600	40,454,000	15,529,859	17,604,276	5,757,904	5,101,767	"
	2. International Power and Paper Company of Newfoundland.	£2,433,250	10,122,320	£5,000,000	Incorporated above.				"
	3. Canadian International Paper Company.	103,705 (100 dols.)	—	1,194,300	—	"	"	—	"
	4. International Hydro-Electric System.	3,475,000 (N.P.V.)	—	30,000,000	—	—	—	—	—
	1. Canadian Hydro-Electric Corpn.	1,000,000 "	37,500,000	—	—	4,367,393	—	3,493,009	American Stock Ownership.
	1. Gatineau Power Co.	500,000 "	25,000,000	71,044,500	Incorporated above.				—
	2. Gatineau Electric Light Company.	—	—	—	—	—	—	—	—
	3. St. John River Power Company.	—	—	—	—	—	—	—	—
Canadian Niagara Power Company.	—	300,000 (N.P.V.)	—	6,480,000	(Consolidated with that of parent company).				Niagara Power Corporation.
Abitibi Power and Paper Company.	—	988,117 (N.P.V.)	35,818,000	50,000,000	—	—	4,213,489	7,380,964	American Chairman and Director.
	1. Kaministiquia Power Co.	—	—	—	—	—	—	—	—
	2. Abitibi Electrical Development Co.	—	—	—	—	—	—	—	—
Minnesota and Ontario Paper Company.	—	93,920 (100 dols.)	3,756,000	25,000,000	—	—	5,234,465	—	Backus - Brooks Co.
	1. Ontario and Minnesota Power Co.	—	—	—	—	—	—	—	—
	2. Fort Frances Pulp and Paper Co.	—	—	—	—	—	—	—	—
	3. Keewatin Power Co.	—	—	—	—	—	—	—	—
Spruce Falls Power and Paper Company.	—	200,000 (N.P.V.)	13,900,000	15,000,000	—	—	—	—	Kimberley-Clark Co. and <i>New York Times</i> .
Bathurst Power and Paper Company.	—	700,000 "	—	—	—	—	—	411,782	International Paper and Power Co.
	1. Bathurst Electric and Water Power Co.	—	—	—	—	—	—	—	—
Lake St. John Power and Paper Company.	—	100,000 "	3,070,000	8,000,000	No statement published.				Hearst Interests.
New Brunswick Power Company.	—	20,000 "	1,350,000	2,181,000	740,520	—	190,319	—	Federal Light and Traction Co.
Cape Breton Electric Co.	—	11,250 (100 dols.)	314,000	1,096,000	656,656	667,849	75,622	71,864	Stone & Webster.
	1. Sydney Mines Elec. Co.	—	—	—	—	—	—	—	—
	2. Sydney and Glace Bay Railway Co.	—	—	—	—	—	—	—	—
Lower St. Lawrence Power Company.	—	20,000 (N.P.V.)	—	1,208,000	188,261	—	133,907	—	Central Public Service Co.
	1. Matapedia Valley Light and Power Co.	800 "	—	341,400	—	—	—	—	—
International Utilities Corporation.	—	11,186,342 (dols.)	18,939,145 (dols.)	—	5,742,764	—	2,560,809	—	American ownership.
	1. Canadian Utilities Ltd.	(Natural Gas.)	—	—	—	—	—	—	—
	2. North-Western Utilities Ltd.	—	—	—	—	—	—	—	—
	3. Nanaimo Electric Light, Power and Heating Co.	—	—	—	—	—	—	—	—
	4. Duncan Utilities, Ltd.	—	—	—	—	—	—	—	—
	5. Union Power Co., Ltd.	—	—	—	—	—	—	—	—

NOTE.—N.P.V.—No par value.

POWER FINANCE AND IMPERIAL PREFERENCE: CANADA

It is significant that a public undertaking like the Hydro-Electric Power Commission of Ontario should have supported British production even less than the other groups,

TABLE IV—ELECTRICITY SUPPLY IN CANADA

HOLT-GUNDY AND ALLIED GROUPS

I. Capitalization

(1928)

Company.	Main Subsidiaries in Canada.	Common Stock (Number of Shares).	Preferred (Dollars).	Bonds and Debentures (Dollars).	Gross Earnings (Dollars).		Net Earning (Dollars)		
					1927.	1928.	1927.	1928.	
Montreal Light, Heat and Power Consolidated	—	2,041,837	—	29,549,000	20,314,902	21,235,991	9,816,007	10,794,978	
	1. Montreal Light, Heat and Power Company	28,800,000 dols.	—	7,500,000	Incorporated in above.				
	2. Montreal and St. Lawrence Light and Power Company	2,250,000 "	—	—	"	"	"	"	
	2. New England Hydro-Electric Corporation	2,750,000 "	—	—	"	"	"	"	
	3. Montreal Hydro-Electric Co.	350,000 "	—	2,968,000	"	"	"	"	
	4. Montreal Island Power Co.	45,000 "	—	200,000	"	"	"	"	
	5. Cedar Rapids Manufacturing Co.	75,000 (N.P.V.)	—	8,000,000	"	"	"	"	
	6. United Securities Ltd.	8,900,000 dols.	—	14,407,000	"	"	"	"	
	1. Canada Light and Power Co.	5,126,172 "	4,655,372	3,800,000	610,850	696,899	313,946	342,034	
	1. Canada Light and Power Co.	3,324,800 "	—	3,237,300	347,929	—	225,192	—	
	Shawinigan Water and Power Company	—	1,867,972 (N.P.V.)	—	45,000,000	9,362,828	11,562,331	4,932,276	7,098,524
		1. St. Maurice Power Company	7,200,000 dols.	—	—	1,263,517	—	1,027,027	—
		2. North Shore Power Company	1,000,000 "	—	4,800,000	—	—	—	—
		3. Quebec Power Company	502,877 (N.P.V.)	—	12,000,000	1,572,230	3,198,487	1,256,227	1,970,304
		1. Quebec Railway, Light, Heat and Power Co.	2,500,000 dols.	—	—	—	—	—	—
	Canada Power and Paper Corporation	4. Beauharnais Electric Co.	425,000 "	75,000	1,220,000	133,459	—	23,408	—
5. Laurentide Power Co.		10,500,000 "	—	8,157,500	1,491,327	—	1,247,404	—	
Price Brothers & Company	1. St. Maurice Valley Corporation	688,000 (N.P.V.)	—	28,800,000	—	—	—	5,376,585	
	1. St. Maurice Valley Corporation	160,000 "	10,000,000	9,999,833	—	—	4,689,674	4,735,586	
Price Brothers & Company	—	42,683,200 dols.	7,000,000	14,342,000	—	—	4,063,211	4,079,573	
	1. Donnacona Paper Company	150,000 (N.P.V.)	—	11,000,000	—	—	—	869,763	
	2. Quebec Pulp and Paper Corporation	100,000 "	7,000,000	—	—	—	—	—	
	1. Saguenay Light and Power Co.	—	—	—	—	—	—	—	

* With Power Corporation of Canada.

† With Shawinigan Water and Power Co.

the British percentage being 0.5 per cent. This undertaking has purchased plant from Germany, Sweden, and Switzerland in preference to Britain, and even in

THE HOLT-GUNDY AND NESBITT-THOMSON GROUPS

preference to home production, since in steam turbines Canadian firms supplied 33 per cent and in generators 85 per cent, or 59 per cent for the combined installation.

TABLE V—ELECTRICITY SUPPLY IN CANADA

NESBITT-THOMSON AND ALLIED GROUPS

I. Capitalization

Company.	Main Subsidiaries in Canada.	Common Stock (Number of Shares).	Preferred (Dollars).	Bonds and Debentures (Dollars).	Gross Earnings (Dollars).		Net Earnings (Dollars).	
					1927.	1928.	1927.	1928.
Power Corporation of Canada	—	200,205 (N.P.V.)	10,000,000	14,979,000	796,635	2,128,641	661,453	1,624,186
	1. East Kootenay Power Co.	30,000 "	1,000,000	2,221,000	408,706	422,586	282,549	248,641
	2. Canada Northern Power Corporation	75,000 "	5,000,000	15,000,000	2,812,514	—	1,961,701	—
	3. Great Northern Power Corporation	12,500 "	—	—	—	—	—	—
	4. Northern Ontario Light and Power Co.	4,585,000 dols.	—	—	1,281,432	—	815,119	—
Southern Canada Power Co.	3. Northern Ontario Power Co.	190,000 (N.P.V.)	2,400,000	—	—	—	—	—
	4. Northern Quebec Power Co.	20,000 "	—	2,650,000	—	—	—	—
	5. Northern Canada Power Co.	6,000,000 dols.	—	1,000,000	—	—	—	—
	—	400,000 (N.P.V.)	4,975,700	6,000,000	1,534,280	1,809,566	991,266	1,203,801
	1. Sherbrooke Rail- way and Power Co.	1,127,000 dols.	—	1,039,000	—	—	—	—
Dominion Power and Transmission Co.	—	7,700,000 "	5,411,000	5,192,000	3,479,622	—	1,049,616	—
Winnipeg Electric Co.	1. Hamilton Cataract Power, Light and Traction Co.	1,700,000 "	2,909,000	2,810,000	5,868,142	Incorporated in above.		
	2. North-Western Power Co. (incor- porated in 1928).	199,798 (N.P.V.)	4,156,900	2,043,000	—	—	2,206,434	—
British Columbia Power Corporation	—	150,000 "	—	10,000,000	—	—	231,108	—
	—	2,000,000 (N.P.V.)	—	—	Holding Company.			
	1. British Columbia Electric Railway Co.	£3,846,103	£1,440,000	£5,108,710	2,435,226*	2,063,667†	709,555*	946,247†
	2. Vancouver Power and Gas Power Co.	15,248,012 dols.	5,000,000	—	—	—	—	—
	3. Western Power Co.	9,500,000 "	—	£1,500,000	Incorporated in above.			
The Great Lakes Power Co. Canadian Power and Paper Investment Co.	1. Burrard Power Co.	5,000,000 "	850,000	4,895,000	—	—	—	—
	4. Vancouver Island Power Co.	350,000 "	—	—	—	—	—	—
	—	3,500,000 "	—	—	—	—	—	—
—	—	20,000 (N.P.V.)	—	2,650,000	563,748	550,774	338,749	336,713
—	—	100,000 (N.P.V.)	2,500,000	2,500,000	—	488,769	—	328,891

* Year ending June 30, 1927.

† Nine months—March 31, 1928.

This undertaking should have been in a position to support the policy of the Canadian Government much more effectively than the other groups noted, but it has preferred to purchase its plant from countries other than Great Britain.

POWER FINANCE AND IMPERIAL PREFERENCE: CANADA

TABLE VI—ELECTRICITY SUPPLY IN CANADA

INDEPENDENT COMPANIES

I. Capitalization

Company.	Main Subsidiaries in Canada.	Common Stock (Number of Shares).	Preferred (Dollars).	Bonds and Debentures (Dollars).	Gross Earnings (Dollars).		Net Earnings (Dollars).	
					1927.	1928.	1927.	1928.
Hydro-Electric Power Commission of Ontario	—	—	—	176,373,418	23,537,107	25,561,317	7,132,338	9,071,697
West Kootenay Power Company	—	5,112,000 dols.	500,000	2,383,000	1,923,702	2,133,526	1,401,016	1,597,120
	(1) South Kootenay Water Power Co.	—	—	—	—	—	—	—
	(2) Cascade Water Power and Light Co.	300,000 "	—	119,000	—	—	—	—
	(3) Rossland Water and Light Co.	—	—	—	—	—	—	—
	(4) Okanagan Water Power Co.	—	—	—	—	—	—	—
Calgary Power Company	—	2,500,000 "	4,000,000	£552,200	496,383	949,422	337,894	517,163
Ottawa Light, Heat and Power Company	—	3,500,000 "	1,500,000	3,225,000	1,920,942	2,035,184	659,757	638,579
Nova Scotia Power Commission	—	—	—	5,400,000	—	—	—	—
Nova Scotia Light and Power Company	—	34,523 (N.P.V.)	750,000	3,500,000	1,472,664	—	557,706	—

There can be no question about the capacity of the British firms to meet all the requirements of these contracts, even in water turbines. The description of British installations of this nature in India, New Zealand, Brazil, Chile, Great Britain, and Canada itself is sufficient evidence of their capacity to supply highly efficient plant at an economic price. The main question at issue lies in the allocation of tenders themselves. In a considerable number of cases British firms have not been invited to tender for large installations, with the result that, as far as electrical trade with Canada is concerned, practically no importance can be attached to any political movement based on Imperial Preference. Power finance has become so dominant in that market that it has ceased to be an open market in any sense of the word. It is more rigidly protected than if it had been surrounded by the highest tariff in the world.

The question, then, is: Is it impossible to improve the British position in this Dominion? When one considers that foreign firms located in Germany, Sweden, and Switzerland have supplied almost 500,000 H.P. of turbines and 136,000 kilowatts of generators, the possibility of British firms competing scarcely enters into discussion. The greater part of the 500,000 H.P. of turbines should have gone to this country. There is also the consideration that Canada itself is a rapidly growing market, and its growth is not yet entirely under the control of the companies listed above. It should be possible for British industry to develop power finance more

AMERICA CONTROLLED COMPANIES IN CANADA

fully, with a view to entering into the Canadian market and securing a much higher percentage of the business.

In its movement towards penetration, British industry should be assisted by financial institutions in this country. At the present time such assistance has not been forthcoming. Canadian supply companies have been assisted in two ways by

TABLE VII—ELECTRICITY SUPPLY IN CANADA

AMERICAN-CONTROLLED COMPANIES

II. *Generating Plant Capacity and Output*

Company.	Capacity of Generating Plant (H.P.).	Output of Electricity, (1928).
Duke-Price Power Co.	450,000	2,096,900,000
Gatineau Power Company	480,750	1,295,200,000
St. John River Power Company	40,000	—
	(under construction)	
Canadian Niagara Power Company	121,900	621,400,000
Abitibi Power and Paper Company	106,000	337,600,000 (1926)
Kaministiquia Power Company	35,570	69,700,000
Ontario and Minnesota Power Co.	51,850	36,500,000 (1926)
		(Fort Frances station only 15,350 H.P.)
Keewatin Power Company	30,875	84,749,100 (1926)
Spruce Falls Power and Paper Co.	58,750 (56,250 under construction)	9,210,000 (1926)
Bathurst Company, Ltd.	13,000	41,017,400 (1926)
New Brunswick Power Company	6,600	9,353,975 (1926)
Lower St. Lawrence Power Co.	3,700	5,064,000 (1926)
Cape Breton Electric Company	2,795	—
Nanaimo Electric Light, Power and Heating Company	1,865	2,289,745 (1926)
Duncan Utilities	400	455,490 (1927)
Union Power Company	5,098	—
Total	1,414,153	4,609,440,120*

* About 5,400,000,000 units, including all plants at completion.

the City. First of all, their shares are quoted on the Stock Exchange. This applies, above all, to companies like the Abitibi Power and Paper Company, the Duke-Price Power Company, Shawinigan Water and Power Company, Price Brothers and Company, Montreal Light, Heat and Power Consolidated, and the Power Corporation of Canada. In other words, through such quotation, the market value of the capitalization of the companies has been raised to a higher level than it would otherwise have been, and this is an important consideration in view of the Canadian methods of financing through the issue of common stock. Such a

POWER FINANCE AND IMPERIAL PREFERENCE: CANADA

TABLE VIII—ELECTRICITY SUPPLY IN CANADA

HOLT-GUNDY AND ALLIED GROUPS

II. Generating Plant Capacity and Output

Company.	Capacity of Generating Plant (H.P.).	Output of Electricity (Units).
Montreal Light, Heat and Power Consolidated	278,325	1,252,502,612 (1926)
Canada Light and Power Company	30,400	88,832,500 (1926)
Shawinigan Water and Power Company	197,000	886,563,710 (1926)
St. Maurice Power Company	132,880	590,100,000 (1926)
Laurentide Power Company	176,000	837,700,000 (1928)
Quebec Power Company	50,204	115,800,000 (1926)
North Shore Power Company	22,400	5,166,200 (1926)
St. Maurice Valley Corporation	6,000	—
Price Brothers & Company	70,100	171,300,000 (1926)
Saguenay Electric Light and Power Company	7,200	24,000,000 (1926)
Total	970,509	3,970,965,022

TABLE IX—ELECTRICITY SUPPLY IN CANADA

NESBITT-THOMSON AND ALLIED GROUPS

II. Generating Plant Capacity and Output

Company.	Capacity of Generating Plant (H.P.).	Output of Electricity (Units).
Southern Canada Power Company	59,080	141,300,000 (1928)
East Kootenay Power and Light Co.	23,524	59,500,000 (1926)
Great Northern Power Corporation	4,000	2,800,500 (1926)
Northern Canada Power Company	67,800	166,827,060 (1926)
Northern Ontario Light and Power Company	21,540	94,750,820 (1926)
Dominion Power and Transmission Company	75,330	232,700,000 (1926)
Winnipeg Electric Company	50,500	654,500,000 (1928)
Manitoba Power Company	112,000	
Vancouver Power Company	101,500	390,600,000 (1928)
Western Power Company	77,500	
Vancouver Island Power Company	25,000	
Burrard Power Company	12,500	
Great Lakes Power Company	28,050	109,365,464 (1926)
Total	658,324	1,852,343,844

INDEPENDENT COMPANIES AND MUNICIPALITIES

TABLE X—ELECTRICITY SUPPLY IN CANADA

INDEPENDENT COMPANIES

II. *Generating Plant Capacity and Output*

Company.	Capacity of Generating Plant (H.P.).	Output of Electricity (Units).
Hydro-Electric Power Commission of Ontario	1,075,659	4,104,500,000 (1928)
Nova Scotia Light and Power Co.	8,308	2,357,000 (1926)
West Kootenay Power Company	174,020	516,000,000 (1928)
Ottawa Light, Heat and Power Company	19,400	25,250,000 (1926)
Calgary Power Company	31,600	79,109,100 (1927)
Nova Scotia Power Commission	28,815	51,164,000 (1926)
Total	1,337,802	4,778,380,100

TABLE XI—ELECTRICITY SUPPLY IN CANADA

MUNICIPALITIES

Municipality.	Total Capital Expenditure (Dollars).	Capacity of Generating Plant (H.P.).	Output of Electricity (Units).
Winnipeg	16,125,900	120,540	388,900,000 (1928)
Regina	2,337,785	24,119	25,851,000 (1926)
Saskatoon	1,920,556	13,700	19,257,000 (1926)
Calgary	2,665,000	14,650	1,798,000 (1926)
Edmonton	1,850,665	17,600	37,492,900 (1926)
Lethbridge	703,300	5,800	5,437,830 (1926)
Medicine Hat	514,585	4,000	9,386,960 (1926)
Kamloops	593,627	4,000	5,284,470 (1926)
Orillia	728,232	6,360	19,935,500 (1926)
Moose Jaw	1,110,000	7,999	14,500,000 (1926)
Total	28,549,640	218,758	527,843,660

method allows these companies to raise their capital much more easily than would otherwise have been the case, and when one finds that such new capital is devoted to the purchasing of plant and materials in the United States and countries other than Canada, one can scarcely regard such quotations in London as being helpful to British electrical export trade.

In the second place, a number of these companies have raised their capital in London. This observation applies, above all, to the British Columbia Electric Railway Company and its subsidiary, the Vancouver Power Company. It is difficult to find, in particulars of the equipment of the systems operated by these

POWER FINANCE AND IMPERIAL PREFERENCE : CANADA

undertakings, evidence to show that a satisfactory percentage of this capital has been spent in this country. The same observation applies to the Winnipeg Electric Company, which has not yet placed an order in this country for generating plant and equipment.

Again, we find an enormously powerful corporation, like the International Power and Paper Company, controlling the International Power and Paper Company of Newfoundland, which has not only raised the greater part of its capital in this country, but has enjoyed the advantage of an issue under the Trade Facilities Act to the extent of £2,000,000, while the Newfoundland Government has guaranteed an additional £2,000,000. In this case again, it is doubtful whether a satisfactory percentage of the total capital expenditure has been placed in Great Britain, while such financial facilities as guaranteed by the British and Newfoundland Governments have allowed American penetration to be even more complete into Canada and Newfoundland, the American corporation securing control of the common stock, while expenditure on equipment is met through the issue of bonds and debentures without voting power and guaranteed by those Governments.

The only possibility of meeting such competition lies in a more determined effort to bring to the attention of Canada itself more complete information regarding the technical and economic capacity of the British electrical industry, while coupled with it should be the application of large financial development programmes, based not merely on control but also on the allocation of essential contracts to this country. In this financial development the Canadian Government itself can play an important part, and it is only in such a direction that some reality can be given to the theories of Imperial Preference which have been freely circulated during the last few years.

APPENDIX B
INTERNATIONAL ELECTRICAL EXPORT STATISTICS

APPENDIX B—TABLE I—ELECTRICAL EXPORTS FROM SIX COUNTRIES, 1927 and 1928

(Sterling)

	1927							1928						
	U.S.A.	Great Britain.	Germany.	France.	Switzerland.	Belgium.	Total.	U.S.A.	Great Britain.	Germany.	France.	Switzerland.	Belgium.	Total.
Generators :														
Direct current—under 500 KW.	179,300	423,115						253,900	430,698					
Over 500 KW.	133,700							128,400						
Alternating current—under 2000 KVA.	34,900	672,904						46,700	846,909					
Over 2000 KVA.	224,000							81,300						
Steam turbine generators	195,000	—						176,200						
Accessories and parts	413,000	—						225,500						
Motors—under 1 H.P.	538,000	788,549	2,746,000					606,000	779,133	3,879,000	193,000			
1 to 200 H.P.	632,000							590,000						
Over 200 H.P.	82,700	472,003						79,700	376,157					
Parts for motors	496,000	1,245,769		704,000	1,130,000	224,000	21,378,000	412,000	1,347,200					
Railway motors	188,600	495,159						123,000	475,191			1,442,000	237,500	24,535,000
Transformers—power	319,800	597,371						246,000	583,936					
Other	216,500							170,500						
Converters, rectifiers, etc.	355,900	411,502						232,000	301,886					
Switchboards, except telegraph	335,000	74,516						332,000	72,857					
Starting and control equipment :														
For industrial motors	237,000	1,604,445	4,191,000					311,000	1,709,515	5,355,000	73,000			
For railway motors	50,800							49,200						
Lightning arresters, etc.	149,000							161,000						
Metal conduit, switchboxes, etc.	213,500							274,000						
Switches, etc., over lamps	408,000							361,000						
Accumulators, portable		517,814	506,850	169,100		36,100			481,018	507,900	151,000		43,080	
Stationary		537,386							454,087					
Batteries, storage	756,000				6,000		4,368,000	701,000			2,850	17,190		4,365,000
Flashlight	463,000	14,234	654,000	36,600		6,600		606,000	12,362	616,500	49,400		13,330	
Other primary	501,000	164,234						566,000	133,932					
Watt-hour and other meters	86,300	125,165				4,100		205,000	139,842				2,395	
House service meter parts		6,311					3,287,000		7,126		226,000			
Commercial instruments		184,100	1,626,450	231,000	525,000	2,150			180,115	1,859,950		673,000		3,680,000
Scientific instruments	438,000	58,605						317,000	51,268		21,200		4,710	
Electric lamps	917,500	593,274	1,347,650	165,400	119,100	28,600	3,522,000	943,000	540,227	1,732,600	171,000	139,200	35,849	3,895,000
Searchlights	179,900	21,680	136,650	2,140	1,512	8,400		131,500	13,396	168,750	5,370	1,886	12,400	
Telegraph apparatus	213,500		11,560					178,000		30,750				
Telephone apparatus :														
Instruments	73,300	1,677,166	1,015,450	268,000	38,400	670,000	9,686,000	89,200	1,673,823	1,347,100				
Switchboards	149,700							82,500						
Other equipment	561,000							513,000			329,500	72,100	667,000	10,907,000
Wireless apparatus :														
Transmitting sets	82,600	1,005,233	1,873,450					158,000	950,236	2,456,000				
Receiving sets	610,000							936,000						
Receiving set components and parts	992,000							1,180,000						
Valves	206,600	213,381		36,300				209,000	179,870		34,600			
Wires and cables :														
Rubber insulated		1,448,459				183,000			1,403,186				189,100	
Other insulated		1,581,698				38,000			1,464,828				85,600	
Telegraph and telephone	1,064,000	954,772	1,967,150	254,000	59,000		8,360,000	991,000	855,418	2,021,950	379,000	78,800		8,457,000
Submarine		550,973				263,000			630,301				358,200	
Bells, buzzers, alarms	35,800	8,846	282,900					75,000	7,581	372,000	1,420			602,500
Railway signals	158,300							146,500						
Motor-driven household apparatus	476,000	42,847						446,000	32,335		56,800			
Domestic heating and cooking apparatus			293,550		49,000		1,267,000	252,000		405,350	17,700	76,560		1,399,000
Electric irons	320,020		70,460		14,800			74,440		73,550	2,860	18,510		
Electric furnaces and ovens (industrial)	109,600							93,500						
Medical apparatus		27,117	788,750						29,568	902,850				
X-ray and vacuum tubes	341,800	11,731	84,450				1,254,000	366,000	15,722	113,800	50,300			1,478,000
Electric glassware	48,700	69,576						87,200	71,480					
Electric porcelain	247,500	181,502			3,200	4,000		283,000	187,612		91,500	3,535	4,625	
Insulators with fittings			344,350	117,500	5,100		1,435,000			311,850		2,527		1,509,000
Other insulators	280,200		118,100			14,900		278,000		148,900	24,500		13,990	
Sockets and lighting switches	371,500							398,000						
Lighting fixtures	391,500	650,932					1,490,000	55,000	640,560					1,184,000
Fuses and fuse blocks	76,100							90,000						
Carbons : furnace	382,000	11,640						391,000						
Lighting		2,789				1,421	410,500		13,726				63	404,800
Other		10,053				2,300								
Magnets		11,275	317,600				328,875		40,826	455,150				496,000
Total (including N.E.S.)	18,910,000	18,768,824	19,510,000	2,931,000	2,497,570	1,669,400	64,286,794	20,630,000	18,333,623	23,820,000	3,320,000	3,063,400	1,887,500	71,054,523

APPENDIX B—TABLE III—MARKET DISTRIBUTION OF ELECTRICAL EXPORTS (1928)

(Sterling)

Country of Destination.	1928. Exports of Machinery and Apparatus.						1928. Exports of Machinery.					
	United Kingdom.	U.S.A.	Germany.	Switzerland.	Belgium.	Total.	United Kingdom.	U.S.A.	Germany.	Switzerland.	Belgium.	Total.
British Dominions	11,273,349	9,080,000	892,500	111,910	10,460	21,368,219	4,453,143	1,654,000	349,000	64,400	—	6,520,543
Austria	18,392	42,200	982,000	103,000	—	1,145,592	4,728	4,080	203,000	39,500	—	251,308
Belgium	134,172	227,400	549,000	159,000	—	1,069,572	21,394	57,500	141,500	69,700	—	290,094
Bulgaria	22,514	306	95,800	23,800	—	142,420	313	30	16,280	17,600	—	34,223
Czecho-Slovakia	14,221	14,940	865,000	109,100	—	1,003,261	4,585	2,875	209,500	30,840	—	247,800
Denmark	176,826	54,600	657,000	24,630	—	913,056	21,878	6,330	40,500	10,400	—	79,108
Estonia	1,497	567	64,100	—	—	66,164	84	32	3,580	—	—	3,696
Finland	31,849	21,750	227,000	24,900	—	305,499	15,923	2,524	70,700	8,180	—	97,327
France	336,606	275,100	905,000	244,500	65,600	1,826,806	86,654	82,100	82,100	59,400	13,990	324,244
Germany	137,891	246,500	—	226,200	77,600	688,191	51,414	55,800	—	98,800	—	206,014
Greece	284,099	7,190	130,900	20,400	—	442,589	111,698	991	42,800	6,520	—	162,009
Hungary	16,935	8,020	356,000	23,250	—	404,205	1,781	683	47,500	7,660	—	57,624
Italy	391,030	292,100	1,377,000	168,300	31,100	2,259,530	32,616	39,250	179,900	65,800	—	317,566
Latvia	3,340	657	170,800	—	—	174,797	1,417	257	28,500	—	—	30,174
Lithuania	204	4	90,200	135	—	90,543	107	—	12,220	—	—	12,327
Netherlands	395,494	187,900	2,082,000	221,400	248,200	3,134,994	153,951	9,750	192,500	65,300	65,500	487,001
Norway	52,843	43,200	595,000	39,100	—	730,143	25,299	59,600	95,600	17,620	—	198,119
Poland	25,003	17,990	1,265,000	188,200	—	1,496,193	5,751	2,816	234,700	128,900	—	372,167
Portugal	100,325	41,100	99,500	43,250	440	284,615	21,746	5,120	30,400	20,600	—	77,866
Roumania	30,677	20,100	531,000	50,800	—	632,577	8,207	707	103,000	35,000	—	146,914
Russia	266,992	286,920	2,395,000	12,230	—	2,961,142	239,098	268,000	1,053,000	11,420	—	1,571,518
Spain	291,202	506,000	514,000	473,000	177,500	1,961,702	134,186	202,260	143,500	293,000	—	873,146
Sweden	108,393	106,300	1,209,000	43,400	—	1,467,093	15,798	13,360	123,000	9,650	—	162,808
Switzerland	94,690	64,000	822,000	—	—	980,690	23,076	7,210	93,500	—	—	123,786
United Kingdom	—	1,202,000	1,516,000	75,340	322,300	3,115,640	—	295,200	454,000	20,540	53,800	823,540
Yugo-Slavia	—	3,580	352,000	—	—	355,580	—	178	52,700	—	—	52,878
Mexico	120,495	947,000	165,200	9,980	71,100	1,313,775	58,492	275,000	31,650	6,980	—	372,122
Cuba	4,751	696,000	23,250	6,220	—	730,221	774	59,000	3,180	339	—	63,293
Argentina	1,452,718	1,432,000	1,329,000	81,000	70,900	4,365,718	540,418	287,200	245,000	45,200	11,950	1,129,768
Bolivia	5,326	39,900	14,010	4,190	—	63,426	2,471	18,130	5,840	4,010	—	30,451
Brazil	305,413	1,008,000	416,000	33,100	22,200	1,784,713	128,639	296,200	125,200	24,360	12,650	587,049
Chile	247,385	349,000	182,900	21,900	—	801,185	42,116	95,000	47,800	4,020	—	188,936
Colombia	69,331	447,500	97,000	2,760	—	616,591	12,881	95,600	18,910	1,287	—	128,678
Ecuador	717	39,250	7,160	—	—	47,127	130	10,880	1,540	—	—	12,550
Paraguay	—	3,990	13,480	—	—	17,470	—	366	13,480	—	—	13,846
Peru	29,295	125,000	40,800	15,730	—	210,825	8,852	44,200	7,350	10,530	—	70,932
Uruguay	30,960	159,900	65,700	3,382	—	259,942	13,441	13,600	15,540	1,560	—	44,141
Venezuela	19,173	246,200	28,850	12,000	—	306,223	6,277	56,500	6,550	8,500	—	77,827
China	317,382	405,000	233,500	18,300	—	974,182	99,190	77,300	52,800	10,100	—	239,390
Dutch East Indies	48,124	155,300	427,000	45,200	10,880	686,504	7,997	14,630	85,900	33,200	—	141,727
French Indo-China	603	2,862	—	6,140	—	9,605	165	—	—	6,070	—	6,235
Japan	335,876	914,000	575,000	152,500	—	1,977,376	184,944	319,000	140,600	115,500	—	760,044
Kwantung	—	33,150	—	—	—	33,150	—	18,390	—	—	—	18,390
Persia	47,453	3,440	16,620	—	—	67,513	23,383	915	5,450	—	—	29,748
Philippine Islands	7,699	374,500	10,730	242	—	393,171	741	73,300	2,400	—	—	76,441
Siam	25,102	41,800	29,700	584	—	97,186	7,494	7,440	2,650	27	—	17,611
Syria	386	6,440	—	574	—	7,400	50	4,140	—	29	—	4,219
Turkey	6,529	5,210	147,500	4,880	2,370	166,489	1,836	1,166	31,900	397	—	35,299
Belgian Congo	5,240	76	3,090	—	69,900	78,306	4,461	—	638	—	23,650	28,749
Algeria and Tunis	1,266	508	640	1,460	—	3,874	693	66	245	398	—	1,402
Madagascar	—	24	1,400	—	—	1,424	—	—	—	—	—	—
Liberia	—	3,640	—	—	—	3,640	—	820	—	—	—	820
Morocco	1,279	2,880	3,800	2,298	—	10,257	303	257	344	795	—	1,699
Mozambique	—	15,310	1,900	—	—	17,210	—	4,980	1,570	—	—	6,550
Portuguese Africa	158,930	2,110	—	—	—	161,040	73,852	196	—	—	—	74,048
Canary Islands	2,951	1,970	24,350	—	—	29,271	240	63	4,270	—	—	4,573
U.S.A.	502,933	—	175,100	92,080	9,290	779,403	21,825	—	60,800	59,800	—	142,425

APPENDIX C—THE DOMINIONS AS MARKETS FOR BRITISH
ELECTRICAL PRODUCTS

APPENDIX C—THE DOMINIONS AS MARKETS FOR BRITISH ELECTRICAL PRODUCTS

BRITISH export trade has developed in a fairly restricted range of markets comprised within the Empire, while other countries have been able to expand more fully in markets where the British product has not yet penetrated to any great extent. Political, financial, and transport conditions may account partially for this type of specialization in market distribution. As a matter of fact, the five Dominions—namely, Canada, India, Australia, New Zealand, South Africa—have been responsible between them for about 60 per cent of British electrical exports, while the Empire as a whole, including the Colonies, absorbs rather more than 65 per cent.

From some points of view, such a position may appear a source of weakness, since, of course, the greater the spread of distribution the greater the independence of purely local trade fluctuations, and a fairly regular dissemination of products over a large number of countries would ensure steadiness of demand, and, to some extent, stability of prices. This the British electrical exporter has not been able to achieve. But he is not markedly dissimilar from his German or American confrère. All three countries have been forced to specialize in their market distribution, although the United States is penetrating more and more into what has been regarded as a British preserve—namely, Australia. On the other hand, Great Britain is slowly regaining part of the Canadian trade which it lost to the United States, and has been decidedly more active in Japan during recent years than even before the war.

The fact that the Dominions form so great a proportion of the demand for British products is, provided this demand can be held by the British manufacturer, a favourable sign. The Dominions as a whole represent the most rapidly expanding areas in the world, and their methods of expansion have been peculiarly suited to the types of British exported products. Large-scale water-power and steam-power projects, railway electrification on ambitious lines, and even suburban electrification in Australia, India, and South Africa, as well as the extension of mining, have all brought into prominence the British capacity to carry out a very big scheme successfully in every detail, and they have tended, therefore, to make foreign competition rather less important.

We propose in this Appendix to concentrate attention on the five Dominions. It is difficult to bring the state of demand in these markets into direct comparison with the state of world demand, since import statistics have not been altogether

THE DOMINIONS AS MARKETS FOR BRITISH PRODUCTS

reliable, but comparison between the exports of the five principal manufacturing countries—namely, Great Britain, the United States, Germany, France, and Switzerland, which are responsible for about 87 per cent of the world's export requirements—and the total electrical imports of the Dominions would serve to give one picture of the rate of growth.

Thus, since 1923, as Table I, shows, world demand has risen 21 per cent over the period 1923–27, the rate of growth being fairly steady. 1927 showed a slowing

TABLE I—EXPORT DEMAND FOR ELECTRICAL PRODUCTS

Year.	Exports from Five Countries.	Increase.	Imports into Dominions.	Increase.
1923	£49,560,000	100	£14,507,738	100
1924	53,475,000	108	16,389,705	113
1925	55,884,000	112	17,504,138	120
1926	59,154,000	119	19,395,688	133
1927	59,781,000	121	19,834,719	136

down in the process, but this was made good in 1928, when the total exports could be given as £68,300,000. In the Dominions, on the other hand, progress has been decidedly much more rapid. An increase of 36 per cent was recorded between 1923 and 1927, but, as far as our preliminary statistics go, the increase recorded in all countries in the world generally in 1928 did not find a reflection in the Dominion import figures, which were roughly the same as those for 1927. There would appear to be, therefore, a tendency for the Dominions to slow down slightly in electrical growth, while the rest of the world is drawing into line. In any case, as the statistics show, since 1922 the British electrical exporter has been favoured by peculiarly satisfactory conditions of demand in the Dominions.

If we carry the examination further and make a distinction between electrical machinery and apparatus, we find that apparatus, as Table II. indicates, has moved upwards much more rapidly than machinery. Such a change in the relative position may be due to international competition forcing down machinery prices lower than prices of cables or meters or lamps or accessories; or it may be due to movements in the state of demand itself. One would be inclined to assume that both of these factors have been operating. A country in the first stages of electrification, when power plants are required for large transmission schemes, must necessarily purchase a very high proportion of products entering into the electrical machinery category, but when the first stages of growth have been surmounted, it becomes

IMPORTS OF PLANT AND APPARATUS INTO DOMINIONS

TABLE II—IMPORTS OF ELECTRICAL MACHINERY AND APPARATUS BY FIVE DOMINIONS

(Sterling)

<i>A. From all Countries</i>						
Year.	Electrical Machinery.	Increase (1922 = 100).	Electrical Apparatus.	Increase (1922 = 100).	Total.	Increase (1922 = 100).
1922	£4,900,131	100	£8,555,635	100	£13,455,766	100
1923	4,825,005	99	9,682,733	111	14,507,738	108
1924	5,128,553	104	11,261,152	128	16,389,705	122
1925	5,619,619	114	11,885,519	136	17,504,138	130
1926	5,936,525	121	13,459,163	154	19,395,688	144
1927	5,850,305	119	13,984,414	160	19,834,719	148
<i>B. From Great Britain</i>						
1922	£2,778,457	100	£4,426,350	100	£7,204,807	100
1923	2,426,299	87	5,189,865	130	7,616,164	106
1924	3,366,138	120	6,324,716	159	9,690,854	134
1925	3,706,249	132	6,504,084	164	10,210,333	142
1926	3,668,556	131	7,200,355	181	10,868,911	151
1927	3,622,312	131	7,084,680	178	10,706,992	149

necessary to develop a load sufficient to justify, economically, the original power schemes, and so distribution becomes more and more important. Consumers' apparatus is required to a greater extent than before, and the economic tendency is for the heavy engineering side of the electrical industry to give way slowly to the apparatus side, which covers almost entirely distribution and consumers' equipment, until a point of balance is reached when any further increase in consumption, as represented by the purchase of apparatus, must bring into existence at once a demand for power plant. It is doubtful whether, in the Dominions as a whole, this point has been reached or will be reached for a number of years, and one would expect, therefore, that this lack of balance between electrical machinery imports as against the imports of electrical apparatus will be emphasized rather than reduced, at least for a number of years to come. The balance may be improved with the increasing industrialization of the Dominions, since the erection of manufacturing plants, in the leading industries especially, means a demand for electrical machinery first of all, and only secondarily for apparatus. In Canada, perhaps, the process of industrialization is already sufficiently advanced to increase the demand for electrical machinery, but in that market the greater part of requirements in this line are being met from home production.

THE DOMINIONS AS MARKETS FOR BRITISH PRODUCTS

In the second half of Table II. we show the competitive situation of Britain in the Dominion electrical trade, and it is, on the whole, reassuring—especially in electrical machinery. British manufacturers are securing a much higher proportion of the market now than in 1922 or 1923, and the growth of machinery exports has partly been purchased at the cost of exports from competing countries. That in itself is a very healthy sign, because it shows that the competitive efficiency of the industry in electrical engineering products is very high.

The same observation may be applied, in some measure, to electrical apparatus, but, during the last two years especially, imports from Britain have lost their balance of advantage, and 1927 showed actually a small relative decline. This would prove that, since 1926, British electrical apparatus manufacturers have been yielding ground to manufacturers from competing countries, and are not, therefore, bringing their prices or their competitive enterprise into line with market requirements. Their apparent lack of success was responsible, in 1927, for the loss of advantage established by British firms over all electrical products since 1923, but the position cannot be regarded as altogether unsatisfactory. British firms have been able to secure and maintain their full share of a rising market against competition which has been growing more and more difficult every year, and, on a steadily expanding basis, markets tend to become more diffuse in their demand, with the consequent incursion of new competitors and the tapping of new sources of supply.

Examination of the position in each Dominion in turn, as recorded in the special diagrams, is peculiarly interesting. If we take Canada first, as being the least important of all five from the British point of view, we find that, in machinery and apparatus taken as a whole, the British percentage was in 1922 6·7, in 1923 7·1, in 1924 7·6, in 1925 10·56, in 1926 11·1, but in 1927 it had fallen to 8·9. Prior to that year, the British position had been improving very rapidly, and showed that a definite effort was being made to meet the competition of the United States. The only countries of any importance supplying Canada are Great Britain and the U.S.A., responsible between them in 1926–27 for 96·3 per cent of the total business, so that developments here have been largely a diversion of orders from one country to another. In machinery proper, the figure has fluctuated from 3·2 in 1922 to 7·1 in 1923, 9·3 in 1924, 14·7 in 1925, 24·0 in 1926, and 18·4 in 1927, so that the improvement recorded in this direction is remarkably good, and indicates quite clearly that, with sufficient enterprise on the part of the British manufacturer, Canada can be rendered into a most important source of demand for electrical plant.

If we carry on our examination to India, which has always been noted for its consistent support of British production, and is undoubtedly the best Dominion

THE BRITISH SHARE IN DOMINION MARKETS

market we have at the present time from the point of view both of price and of competition, we find there has been a slight yielding of ground, since 1924 especially, the figures for all products being 74 per cent in 1922, 79.2 in 1923, 79.3 in 1924, 75.0 in 1925, 73.6 in 1926, and 72.5 in 1927. The country principally responsible for this decline is Germany. Thus, the German percentage, which fell from 5.7 in 1922 to 4.4 in 1923 and 2.5 in 1924, moved rapidly up to 7.6 in 1925, declined very slightly to 6.7 in 1926, and recovered its advance to 7.7 in 1927. The American percentage remained almost stationary between 10 and 11. In this market, unlike Canada, the penetration of German products has been a factor intensifying competition, and price considerations have tended to decide the issue in a vast number of small contracts.

In electrical machinery the British percentage was in 1922 76.9, in 1923 73.9, in 1924 87.5, in 1925 82.7, in 1926 81.2, and in 1927 83.3, so that the British firms have practically the entire market, probably due to better sales organization, more effective co-operation in developing power possibilities, and the more rapid adjustment of prices to the state of competition. The only country competing seriously with Britain has been the United States, but its percentage has fallen from 14.7 in 1922 to 7.2 in 1927, the decline being fairly continuous over the six years. As in Canada, therefore, the electrical engineering section of the industry has been much more enterprising than that devoted to the marketing of apparatus, and has secured a much greater measure of success.

The third Dominion, Australia, is slightly less satisfactory in this respect. Thus the British share of this market stood in 1922 at 65.0, in 1923 at 58.9, recovered again to 68.5 in 1924, lost ground slightly to 66.0 in 1925, lost ground further at 64.4 in 1926, but, as far as our preliminary figures show, gained ground again in 1927, the main factor of importance in this case being the penetration effected by the American manufacturer. In 1927 the American manufacturer secured 29.1 per cent of the total business, compared with 25.6 in 1922 and 27.2 in 1926. Other countries are of practically no importance, and the struggle is, therefore, confined to the manufacturers of Great Britain and the United States.

The British manufacturer has not been relatively so successful in the export of electrical machinery to Australia as to India, and he has not the same rate of progress to show as in Canada. In 1922 his share of the market was 58.5 per cent, compared with the American 37.1, both countries therefore accounting for 95.6 per cent of the total demand. The British figure declined very slightly to 58 per cent in 1923, and the American fell to 32.8, other countries making good the defects recorded. In 1924 the British manufacturer secured 71.4 per cent of the business, and the

THE DOMINIONS AS MARKETS FOR BRITISH PRODUCTS

American share fell further to 22·8. The high figure of 1924 could not be retained in 1925, Britain securing 67·3 per cent and the United States 21·1, the share of the two countries being now 88·4 per cent, so that the United States were yielding ground to new competing countries, mostly from Europe. In 1926 a return to the 1923 position was made, with both countries supplying 90·8 per cent of the business, Britain exporting 59·5 per cent and America 31·1. In 1927 Britain improved her position to 68·2 at the expense of the United States, the total participation of both countries being definitely higher. Australia has shown a greater readiness to use British apparatus, and especially British cables, than either India or Canada, and manufacturers in this branch of industry have been able to maintain their position intact since 1922. On balance, however, Britain has not lost ground, and will share in any marked advance that takes place in demand without difficulty.

New Zealand is, with the exception of Canada, the least satisfactory of the Dominions. It has divided its orders between three countries, Great Britain, America, and Belgium. Thus in 1922 the British proportion stood at 60·3 per cent, the American at 20·6, the Belgian at 11·2, all three countries accounting for 92·1 per cent of the market. In 1923 the British and American figures had risen to 66·8 and 22·2 respectively, and the Belgian had fallen to 2·7. In 1924 the British figure had improved still further to 67·4, and the American had declined to 18·9, while the Belgian remained stationary. In 1925 the British figure was slightly less at 66·2 per cent, the American figure also less at 18·2, while Belgium had climbed up to 4·96. In 1926 Britain relapsed to 60·5 per cent, America rose abruptly to 22·9, while imports from Belgium were negligible. In 1927 the British figure had fallen again to 58·9 and the American to 21·7, while Belgium had risen to 3·5. The market, therefore, as far as Belgium is concerned, is one of large contracts rather than of definite penetration over a long period, but the British proportion of 58·9 per cent cannot be regarded as very satisfactory. It shows that, in this market, there is room for more intensive cultivation or better support by the New Zealand Government of British production, since electrical development on a large scale in that Dominion is largely under State control.

In machinery the position is rather better in New Zealand than in apparatus, the only two competing countries being Britain and the United States. The British proportion was 65·8 per cent in 1922, 62·8 per cent in 1923, 63·7 in 1924, 63·2 in 1925, fell to 49·5 in 1926, owing to a big shipment of Swedish hydro-electric plant accounting for 20·3 of the business, and rose again in 1927 to 62·2 per cent. On the whole, therefore, with the exception of the one contract which went to Sweden,

THE MAIN SUPPORTERS OF BRITISH PRODUCTION

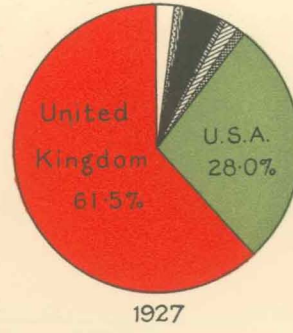
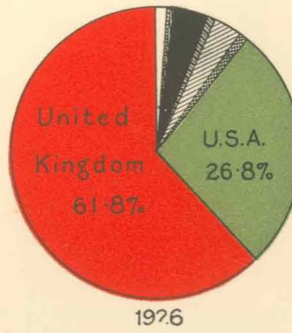
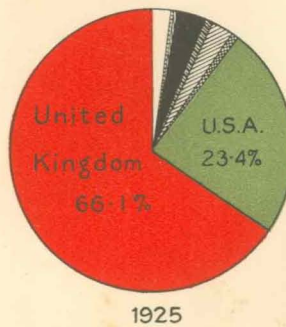
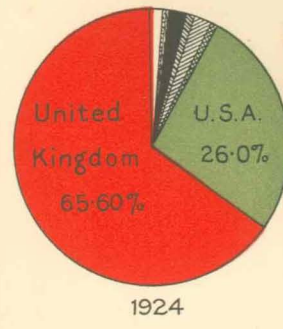
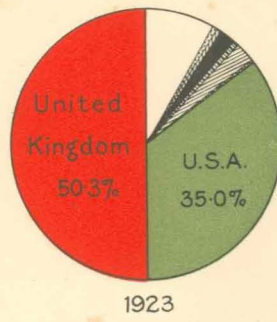
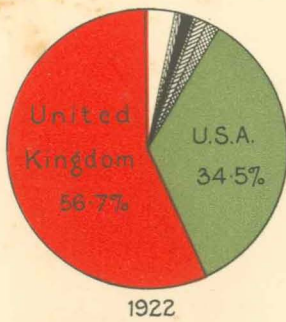
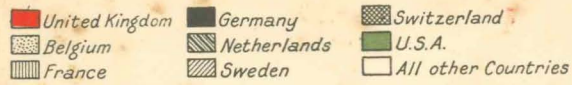
the machinery position in New Zealand is more or less satisfactory, although there has been a slight yielding of ground.

South Africa, the last of the five, shares pride of place with India as a steady supporter of British production, and it is significant that this market, as much as India, has been less concerned with purely political questions of imperial preference than with the actual competitive values of the British product, so that the success achieved here has been in very great measure due to the real competitive efficiency of the industry and not to sentiment. Germany, of course, plays a part of some importance. Thus the market in 1922 was divided in the proportion of 70·3 per cent, 12·6 per cent, and 9·8 per cent between Great Britain, the United States, and Germany respectively, all three countries accounting between them for 92·7 per cent of the market. In 1923 the corresponding percentages for all three countries were 67·7, 15·6, and 9·4, the U.S.A. improving her position at the expense of Britain. In 1924 it was Germany's turn to lose ground to Great Britain, the percentages being 69·0, 15·1, and 6·6. In 1925 both Germany and the United States lost ground considerably to Britain, the relative positions being 77·4 per cent, 9·57, and 6·35. In 1926 Germany and the United States recovered ground slightly, the British total being now 72·3, America 12·7, and Germany 7·4. In 1927 U.S.A. gained ground still further, Britain securing 70·3 per cent, U.S.A. 14·8, and Germany 6·1 per cent of the total business. These figures would indicate the intensification of competition from America and Germany, with, however, little evidence of permanent success. Britain has not yet yielded all the ground it has secured since 1924.

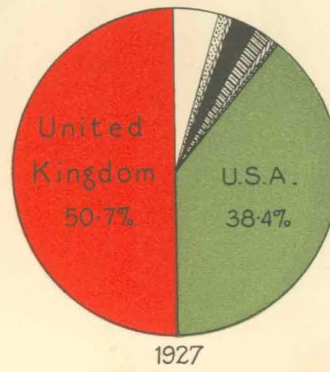
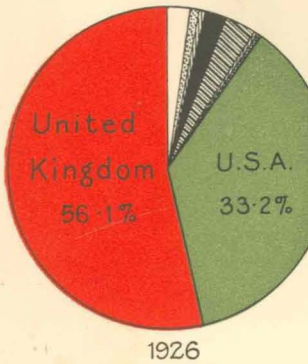
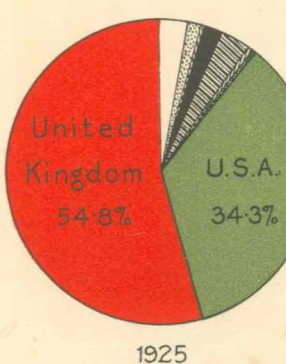
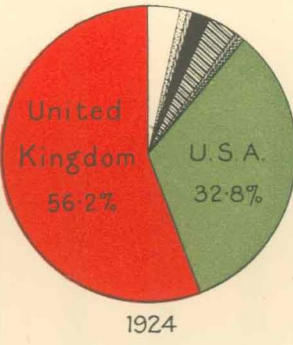
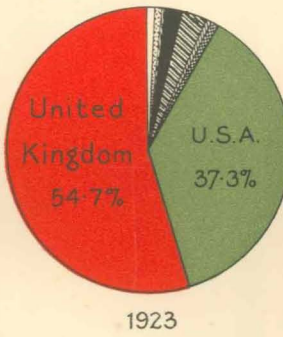
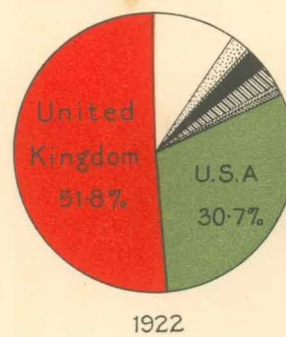
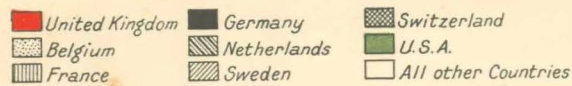
In machinery alone, Britain supplies now an even higher proportion. Thus in 1922, with competition from Germany, U.S.A., and to some extent Sweden, Britain secured 70·9 per cent of the business, in 1923 63·4 (a large German shipment causing the decline), remained at 64·4 in 1924 (Germany and the U.S.A. between them occupying a strong position), improved rapidly to 76·8 at the expense of the U.S.A. in 1925, fell slightly to 73·0 in 1926, owing to Germany securing business both from Britain and the United States, and rose again to 74·8 in 1927 at the expense of Germany.

The one conclusion that emerges quite clearly from this survey is that electrical engineering is definitely more efficient than other branches of the business in this country. There may be some explanation for this, other than that of prices or of quality or of efficiency, but it has been strikingly apparent since 1922.

THE DOMINION MARKET FOR ELECTRICAL PRODUCTS

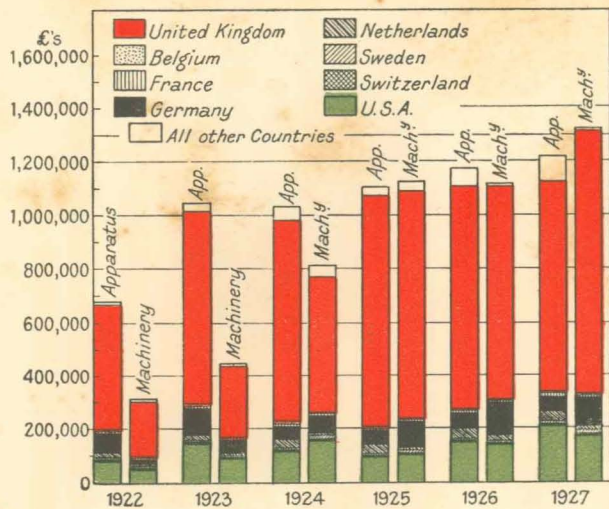


Electrical Machinery

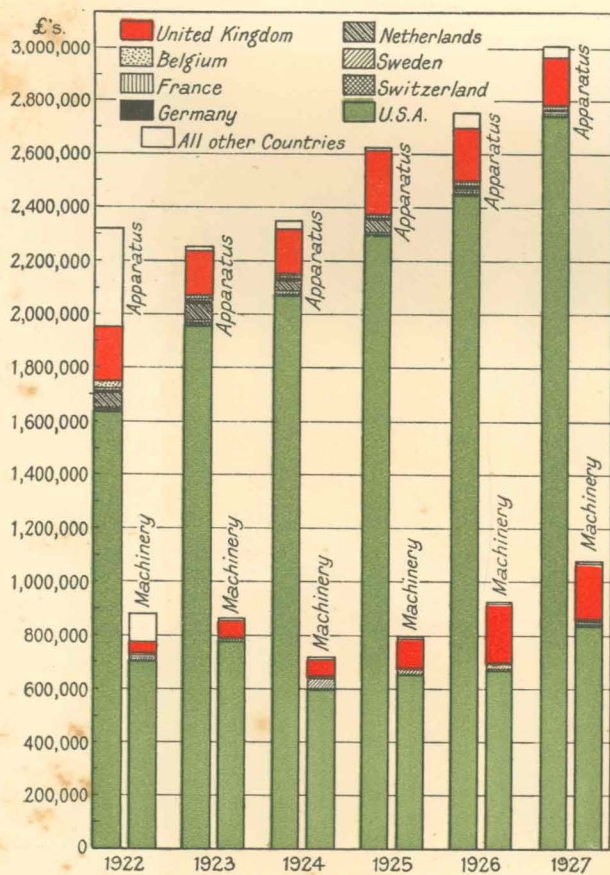


Electrical Apparatus

ELECTRICAL IMPORTS OF DOMINIONS



South Africa

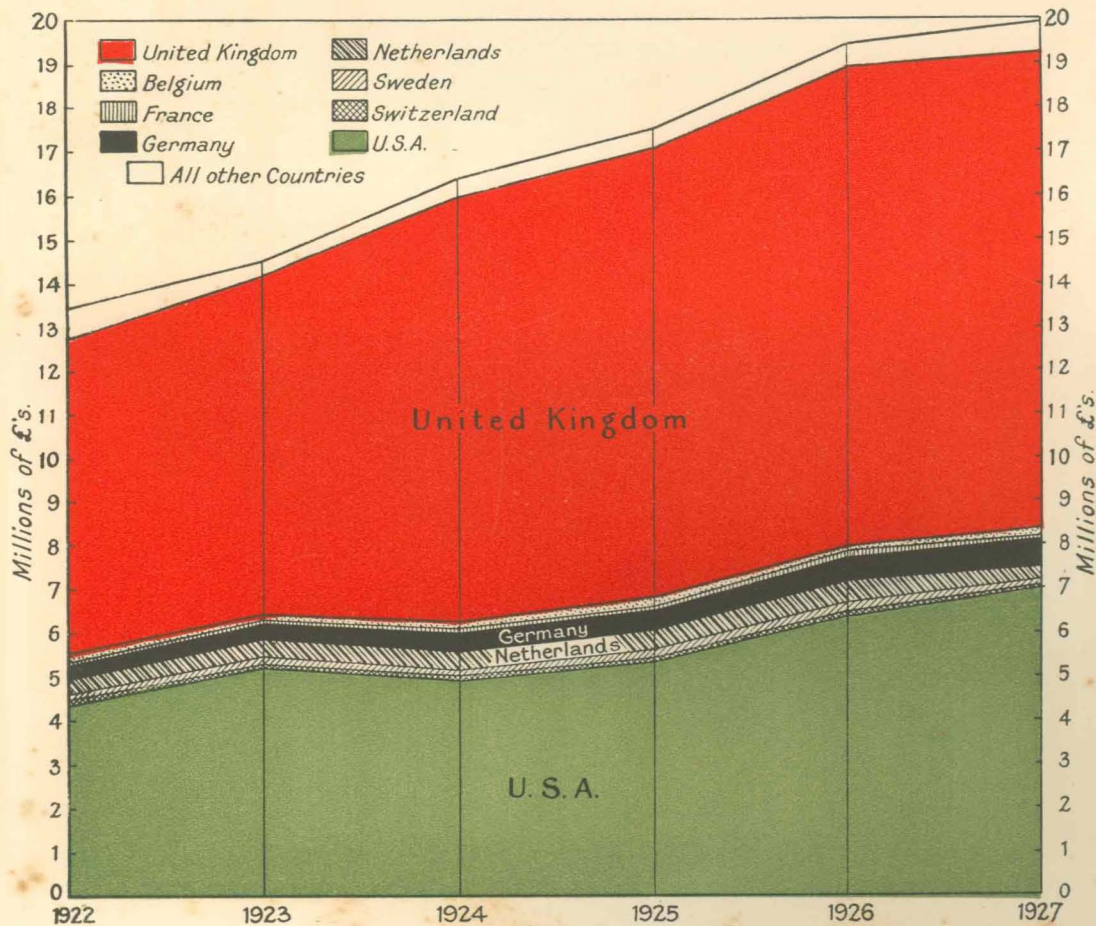
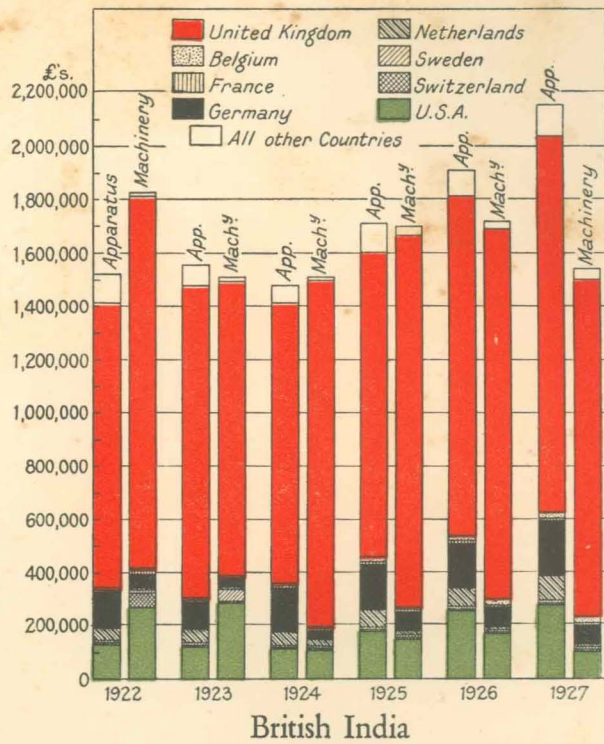
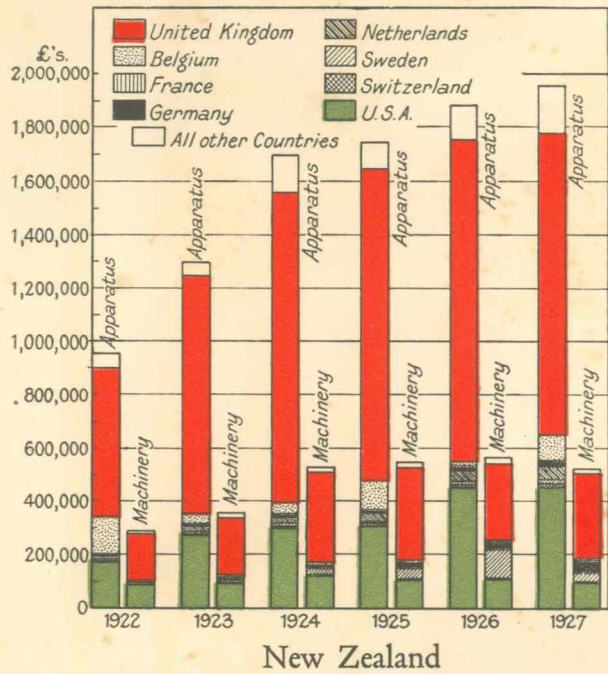


Canada



Australia

ELECTRICAL IMPORTS OF DOMINIONS



All Dominions
(Electrical Machinery and Apparatus)

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