

REPORT
OF
THE SEVENTH
INDIAN INDUSTRIAL
CONFERENCE

HELD AT CALCUTTA

ON THE

29th December, 1911



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INTRODUCTION.

'The healthy atmosphere of industrialism is destructive of sedition ; art, industry and commerce are incompatible with turbulence ; they cannot co-exist with disorder, and grow best in peace ; a vigorous Industrial India will have no room for the anarchist, and will contain germs of social and political progress that are bound to fructify under the beneficent influence of England.' (The Hon'ble Mr. M. B. Dadabhoj in his Presidential address p. XII).

'United, homogeneous India will not only be a political power, but will also grow into a great Industrial India, which will retrieve the lost reputation of Indian art and industry, and usher into the stage of the world a real, living, Glorious Ind. We sons of India, are we so obtuse as not to perceive these simple truths, and are we so wanting in patriotism and public spirit, are we so dead to our own interests as not to be able to adopt the organisation of our society to modern needs ? We are all sons of the same Mother ; let us live like brothers, animated by the same feelings, aspirations and ideas, and work shoulder to shoulder for the common weal and the glorification of our dear Motherland. (*Ibid* p. XLVI).

'We can draw a sober conclusion from the history of others that have trod the path before us, and advance, without fear, with hope of the ultimate future, and with the full trust and belief that the Power that made this world and all that is in it, is fulfilling its own purpose in ourselves, for the benefit of the whole created universe. (Mr. C.E. Low, p. 22).

The Seventh Indian Industrial Conference, it must be regretfully admitted, was not as great a success as some of its predecessors have been. The fact that its session invariably follows that of the Indian National Congress year after year, has always stood in the way of its receiving that attention and rousing that interest, which it otherwise would. But this was a disadvantage which the last session of the Conference laboured under in no greater degree than the previous ones. And it is to the special circumstances of last December that we must look for the comparative feebleness of interest which its proceedings roused. In the first place, the Royal Visit took possession of the popular mind to an extent that left little

room for other matters. Further the entry of Their Majesties, the King-Emperor and the Queen-Empress into Calcutta was to take place the day next after the Conference and the excitement and feeling created by the momentous announcement at the Delhi Durbar about the transference of the Imperial Capital from Calcutta to Delhi and the modification of the partition may in a special degree be held responsible for the seemingly more-than-ordinary lack of enthusiasm.

As the sittings of the Social Conference and the Industrial Conference were both to behold on the 29th, the Industrial Conference was granted the use of the Congress pandal for only 8 hours in the morning. The whole business had to be transacted at express-train speed. These are drawbacks which, there seems to be no way to get over, so long as a large number of such important functions, as the annual meetings of the Indian National Congress, the Indian Industrial Conference, the Social Conference, the Temperance Association, Theistic Conference etc. have to be compressed within, the short space of four or five days, at times barely half a week. Making due allowances, therefore, for the special circumstances of the year, on a view of the Resolutions recorded at the last Conference, it may be regarded as having achieved a fair measure of success. His Highness the late Maharaja of Maurbhanj as Chairman of the Reception Committee opened the proceedings with a short speech. It used to be a matter of adverse comment against the rich noblemen of Bengal, that they were uniformly indifferent to the industrial development of the country till within very recent times, but there are now signs of awakening visible all round and the interest, that that gifted and amiable ruler, we mean, H. H. the late Maharaja, whose untimely death amidst most tragic circumstances is deplored in all parts of India, evinced in industrial regeneration, entitles him to the grateful recognition of his countrymen. The part he took in the organization of the Conference is one further instance of the newly awakened general consciousness. In welcoming the delegates

to the Industrial Conference, whose numbers, it must again be regretfully admitted, left a good deal to be desired, the Maharaja emphasised the supreme importance of industrial advancement to the nation and pointed out how this question must precede all others. India was now a member of an international community and must boldly face international competition. The preparation necessary for India's taking her due share in the strife of industrial and commercial competition lay in the quickened pace at which India's industrial development could be attempted.

After the Maharaja's address Sir R. N. Mookerjee, who had presided at the previous session of the Conference at Allahabad and whose name as one of the most successful industrialists of Bengal is known all over India, proposed the election of the Honorable Mr. M. B. Dadabhoy, C. I. E, Member of the Imperial Legislative Council and a practising Bar-at-Law at Nagpur, to the chair and the proposal was duly seconded by the Honorable Mr. Bhupendranath Basu. Though Mr. Dadabhoy follows the exacting profession of a lawyer, his interest in industrial matters, has always been very keen. He presided in 1907 at the Central Provinces and Berar Provincial Industrial Conference held at Raipur and, what is more, is financially connected with some of the Industrial concerns in the Central Provinces.

It is not always possible to secure industrialists and commercial men of the position of Sir Vithaldas Thackersey or Sir R. N. Mookerjee to preside over the deliberations of the Industrial Conference, but as remarked by the late Maharaja of Maurbhanj in his opening address, the Conference served the important purpose of bringing together the leaders of thought and the pioneers of industry into a common fold, where they could exchange views and give each other the benefit of their experience in a friendly spirit ; and the Honorable Mr. Dadabhoy combining in himself, the qualities of a publicist and the practical industrialist, was just such a man as could undertake a broad and a comprehensive survey of the industrial situation and requirements of the country.

Mr. Dadabhoj's presidential address like his speeches in the Imperial Council is wide in its range and comprehensive in its details. In the criticism of the Hon'ble Mr. Dadabhoj's presidential address that appeared immediately after, it was no doubt said that it contained some glaring contradictions and economic heresies. But such criticism is always to be expected, whenever anything out of the usual platitudes, in which critics live, is uttered by a man who declines to be bound by conventionalities. This is not the place to enter upon any discussion of the soundness or otherwise of some of Mr. Dadabhoj's economic views. It must be acknowledged by every one that Mr. Dadabhoj has left no question, of even the slightest moment to the industrial development of the country, unnoticed.

Starting with the thesis that 'political servitude follows industrial or commercial servitude as night follows day', Mr. Dadabhoj in a few words analyses the causes of what is called 'the Indian unrest' and finds the root cause of it all to be 'the rebellion of the belly'. Industrialism is naturally, therefore, the only and the best antidote. Industrialism is destructive of sedition. There are, already, signs of hope visible on all sides. To quote Mr. Dadabhoj :—

'There is a genuine desire to-day among the people to take to industry and commerce in preference to service. Conservatism is wearing down ; improved methods of manufacture are adopted ; Indian goods find increased sale at home ; and what is more important, hopeful and helpful than any, the artistic taste of the nation has been restored.'

Mr. Havell's paper on the 'Indian builders and Public Work architecture' which finds its proper place in this volume, by the bye, points out what has to be done for the restoration of the artistic taste of the nation.

Mr. Dadabhoj then turns to the examination of the conditions, which are necessary for industrial success, *viz.*, sufficiency of fluid capital, skill, labour and market. With regard to the first, *viz.*, capital, Mr. Dadabhoj demurs to subscribe to the theory of hoarded wealth in India. But speculation on this subject is needless for the simple reason that,

even if, therefore, there be any money in rural India, it, at any rate any appreciable portion of it, cannot and should not be converted into liquid capital for working the industries.'

He then points out the various obstacles, which retard the accumulation of capital in India. Agriculture is heavily taxed, thanks to the short-sightedness and zeal of the Settlement Department. Then again, there is, he says

'the operation of an out-of-date and ruinous law of Succession, The Indian Law of Succession—Hindu and Mahomedan alike—has the greatest disintegrating and deleterious influence upon Indian society, and consequently upon Indian capital' with the result that the total capital is insufficient for any large and comprehensive scheme of industrial regeneration.

Whether Mr. Dadabhoy's view of the unsuitability of the Hindu and Mahomedan Law of Succession is correct or otherwise, whether even the Indian Succession Act is not open to the same criticism, are matters which cannot be dealt with here.

The question of capital naturally leads to the consideration of the employment of foreign capital. The Honorable Sir Vithaldas Thackersey in his Presidential address at the Second Industrial Conference, had pointed out how best to bring foreign capital into the country which it so much needs while at the same time taking care that we did not 'pay more for it than other nations did.' The Joint Stock Banks was the suggested means; these banks by extending their operations to foreign exchanges could take advantage of foreign capital as the other exchange banks were doing at present. In order to prevent foreign capital from being employed in India at a ruinous cost to the latter, Sir Vithaldas had suggested that the legislature should make it obligatory on every industrial concern floated by foreign companies that the same opportunities should be given to Indian capitalists, that the prospectus should be published simultaneously in both the countries, that allotment of shares and other things should be at the same rate and on the same principles. Sir R. N. Mookerjee's suggestion about the revision of Indian Patent Laws, assimilating it in this matter to the

spirit of English Law—that in order to retain the protection given by the Indian Patent Law, it should be necessary to manufacture the patented article, within a specified period, in the country itself—was made in the same spirit. Mr. Dadabhoy however, is prepared to go much further than this. Says he :—

‘ In my humble opinion the people should have the option and the right of buying up the existing industrial concerns owned and managed by European capitalists on terms and conditions that might be settled by Government.’

The suggestion is rather novel, but, if, on maturer consideration, Mr. Dadabhoy is satisfied about its practicability, he will, it is to be trusted, utilize his position in the Council to press it upon government and move them in the matter.

Leaving aside the petty savings of the middle classes, ‘ there is undoubtedly some cash in the hands of the Indian aristocracy and the numerous endowed temples.’ Mr. Dadabhoy pleads for the diversion of this capital into profitable channels. The territorial magnates and the banks must co-operate.

‘ But it seems they are, as a class, not amenable to ordinary influences; they are not moved by large or novel ideas; they require other spurs than nationalism and patriotism to move them to action. Government help is especially valuable in dealing with them.’

Next after capital, comes the necessity of diffusing expert and up-to-date industrial knowledge among the people. On this subject, Mr. Dadabhoy says :—

‘ If expert knowledge meant the exclusion of conventional training and education of the Indian artisan, the splendid skill inherited by him from generations of skilful manipulators would be wholly lost to the nation. That is a view neither sensible nor profitable.’ * * * * *

‘ In the course of an industrial survey Mr. A. Chatterji has noticed a regrettable decline in design in most of the industrial products of the United Provinces. But the alarming feature about it is that it is not endemic.’

Mr. Dadabhoy would, therefore, have the schools of design planted at the selected centres suggested by Mr. Chatterji. Technological institutes and demonstration farms, factories

and tours, exhibitions and all the other modern implements of successful public instruction must all be organized. But

'no system of technical education can be either complete or profitable, which seeks to impart only special knowledge to the neglect of general education. We must have primary education all over India and in a country like India such education, to be effective, should be free and *gradually compulsory*.'

Mr. Dadabhoj seems to have subsequently changed his opinion, as the part he took in the debate on the second reading of the Education Bill would show, about primary education being *gradually compulsory*. But we are not concerned with that in this place. From expert knowledge Mr. Dadabhoj passes on to the consideration of the conditions ruling the Indian labour market. Sir Vithaldas Thackersey had, in 1906, as President of the Conference, complained how in spite of our large population, owing to illiteracy and prejudices concomitant to it, every industry in the land felt the inadequacy of the labour supply. To convert this vast population of ours into an effective labour force, we have first of all to instil into them the rudiments of knowledge. Mr. Dadabhoj, like most other previous Presidents of the Conference urged the same thing and what is more, at that time at least he had, 'lively hopes that free and compulsory Primary Education will improve the character of the masses, and will instill in them a healthy sense of duty and ambition.'

The supply of labour, it was further suggested could be improved by stopping oversea emigration especially as the Indian was not wanted by the white colonist abroad except as a cooly. Further, compulsory legislation like the Assam Labour Law ought to be repealed.

'The existing arrangement is neither moral nor prudent. It is economically unsound. Monopolies are injurious to industrial development.'

From labour, Mr. Dadabhoj goes on to the consideration of the important factor in the scheme of industrial regeneration of this country—the question of the exploitation of foreign markets,

'Government has facilities which no private individual has. Through Government the various British embassies can be utilised for the maintenance at convenient centres of Museums of Indian artwork.'

Moreover, there is the question of prohibitive import duties upon Indian manufactures in foreign countries.

'While we keep our doors wide open for foreign imports, while our market is exploited by foreign manufacturers, our entrance into some of those countries is barred by almost legislative prohibition.'

Mr. Dadabhoj cites some instances of this unfair prohibition and demands Government help in equalising the conditions of mutual commerce. But the more important aspect of this question is that of the home market and Mr. Dadabhoj has dealt exhaustively with it. Like many others before him, he wants a protective tariff and fiscal autonomy. But he clearly sees that there is no immediate chance of Indians getting anything of the kind. In the words of Mr. Dadabhoj

'the British Government from its constitution has to depend upon the Parliamentary support of the powerful British manufacturer; and he will be a bold minister who will do anything to intercept his large profits. India, in the result, is governed in his interest, which is clearly opposed to that of Industrial India.'

In the sequel and another place will be found some of the common arguments urged against protection in a paper by Mr. G. Findlay Shirras. (p. 40²). It obviously looks like a piece of special pleading. The fact seems to be that it is too difficult to attempt anything that may disturb such powerful vested interests, as the English manufacturers have built up in the Indian market. For, after all, it is pre-eminently against English manufacturers and British textile manufacturers in particular that India wants protection at the present moment.

Mr. Dadabhoj suggests various methods by which the exploitation of the home market by Indian manufacturers could be improved. Cheap Railway transport, improvement of water ways, standardization of weights and measures, establishment of commercial and industrial bureaus and national Chambers of Commerce are all touched upon in due order. The ruinous laws of succession among Indians operating

against any large accumulation of capital have already been adverted to above ; Mr. Dadabhoy repeats and deploras the same tendency of these laws at the close of his address, also and points out the place wide reaching social reform occupies in any scheme of industrial regeneration of India.

Before proceeding to take the customary general survey of the papers so kindly contributed by various gentlemen, official and non-official, to this year's Industrial Conference, it is necessary to put in a word of apology for the somewhat unsatisfactory nature of the order in which the papers have been printed in this volume. The arrangement is neither according to the allied nature of the subjects treated in the various papers, nor according to the position and importance of the contributors. In this introduction, however, an attempt has been made to treat the various papers according to the natural affinities of the subject matter. The inconvenience due to the want of proper arrangement, it is hoped, may be partly obviated by references given here to the pages on which the different papers begin.

Since the activities of the organised departments of Agriculture directed the attention to the subject of Indian agriculture and its many wants, any amount of literature, good, bad and indifferent, dealing with it has sprung up on all sides. Non-official gentlemen are showing signs of a healthy rivalry with officials of the department, in awakening and keeping up an interest in the study and improved practice of agricultural methods. Many papers on Indian agriculture and the various aspects of it have already been contributed in the past. The records of the Industrial Conference itself bears ample testimony to the attention bestowed on it. No wonder that very little that can be now said on it—excepting what marks the progress made, in actual practice, in the various branches of agriculture from year to year,—can be regarded as new. Nevertheless, as an index of the increased enthusiasm for agricultural improvement, the two papers 'A plea for Agricultural improvement' by Mr. H. C. Das (p. 35) and 'Agriculture—a retrospect' (p. 77) by Mr. Jogiah will no doubt

be read with great interest. Mr. Das' paper, though no doubt pointing the various directions in which improvements are urgently needed is for the most part an exhortation to educated Indians to take to Agricultural pursuits. The fact that, in the Vedic times, India was a land of Asrams is made a ground for an appeal to them to go 'back to the land.' Says Mr. Das:—

'The ideal of Asram should be revived. The cultured people will live in farms by their honest labour enjoying health of body and mind. They will use their spare time in intellectual and spiritual culture and thus follow the footsteps of the Rishis (sages) of holy memory. Instead of wasting their time and energies in brooding over wild ideas they will apply themselves to practical work. Such farmers will study the problems of the preservation and improvements of plants, fruits, live stock, &c., like the farmers of the West. In short they will combine in themselves the East and West. In America the farmers are not always common labourers, but very often the University professors only re-iterate the experiences of the farmers.'

The vedic Rishi, it is recalled, was a farm labourer and the creation of a class of 'gentlemen farmers' under modern conditions is urged in the following passage:—

'If the agricultural industry is well developed in the country a class of gentlemen farmers will be created and thus the problem of the educated unemployed will become much easier for solution. The poor labourers in the congested areas can be drawn to these farms as labourers and their condition improved. Tea plantations have already shown that this is a fact. When the whole country will be full of different kinds of farms, the poor labourers will be a source of strength to help the industry.'

The writer anticipates no difficulty in educated people, intent upon agricultural pursuits obtaining access to land.

'It is sure the landlords will be glad to get honest and industrious tenants to increase their income and help any reasonable project for the purpose. The young men will need proper guidance and in some cases a little fund to begin with. This can surely be afforded by proper organization.'

Mr. Jogiah's paper presents a long catalogue of things that are urgently needed.

'What we, therefore, ask our Government and the landed aristocracy to do is to give our ryots a sound elementary education, to disseminate broad-cast a knowledge of agricultural science and improve methods of

cultivation. We want them to found scholarships for our young men. We want in every District, in the Head Quarters of the Collector, a branch of the agricultural department under the directions of Agricultural Superintendents with a number of Inspectors under them. We want model farms on an extensive scale to be opened in the Head Quarters of each Taluk with an Agricultural Museum attached thereto which is accessible to the agricultural population. We want tables containing an analysis of soils of each Taluq, so far as practicable, to be prepared and kept in these Museums, so that those ingredients of the manures which are wanting in them may be supplied. We want the Inspectors under the supervision of Superintendents to establish small model farms in rural centres, make experiments, distribute leaflets to the ryots in vernaculars, and lecture, in easy language which they can understand, the advantages of improved methods and demonstrate to them the benefits thereof at their very doors. We want the irrigational facilities to be greatly increased, the permanent settlements to be considerably modified, and the terms of periodical settlements increased. In fact, we want the Government and the landed aristocracy to expand the Agricultural Department and to bring home to the doors of our people in the villages, all the help which modern science has been able to find for the improvement of agriculture.'

This is a formidable array of requisites, to be sure, but it seems well to recognize that there are limits to the pace at which agricultural or any other kind of progress can proceed in India with its ingrained conservatism. These limits were well defined in the paper which Mr. W. H. Moreland, then Director of Land Records and agriculture, U. P. contributed to the first Indian Industrial Conference. He pointed out that the newly organized Agricultural Department was not going to work a sudden revolution.

' Its work may be described as mainly a study of existing practices in the light of agricultural science, to see in what details they can be improved, and what adjustments they need to meet the new conditions involved by the increase of communications and the resultant widening of the market.....The department will be *learning* rather than *teaching* for some years to come.'

Though the considerations urged above remain generally true even to-day, it must be admitted that great improvements have already been effected in agricultural practice in different provinces in various matters. Pump irrigation in

Madrás under the enthusiastic fostering care of Mr. Chatterton and 'the seed farms and distribution of select seed' movement in the Central Provinces and the impetus given to the transplantation of rice and irrigation of wheat may be cited as instances with regard to the question of bringing home the knowledge of improved agricultural methods to the ryots. The Department seems quite alive to the necessity of the same. Dr. Mann at the third Industrial Conference, speaking for the Agricultural Department of Bombay said 'we do not want to be considered as a Government Institution. We exist simply and solely to benefit the cultivator of the Presidency. I want to leave Bombay tomorrow if I cannot do something to help the ryot.' Dr. Stanley Reed, at the same Conference complained that 'between the expert on the one hand and the cultivator on the other there was practically no link' and he advocated the formation of District Agricultural Associations. From the proceedings of the Indian Board of Agriculture which met at Pusa in November last we find that 'the best means of bringing the results of experimental work in Agriculture to the notice of cultivators' is one of the subjects which had engaged their attention. Mr. B. Coventry, Offg. Inspector General of India, said that that was the ultimate aim of their existence and so important was the subject considered that it found a permanent place on every programme of the Board.

From general considerations regarding improvement of Indian Agriculture, we pass on by natural transition, to the consideration of specific agricultural products, of which only three have been taken up for discussion this year. These are cotton, jute and lac. Mr. D. Clouston, Deputy Director of Agriculture, C. P. and Berar has this year contributed a paper on 'Cotton cultivation in the C. P. and Berar studied from an economic aspect.' (p. 22). Mr. Clouston has since the third Industrial Conference been a frequent contributor to the discussion of agricultural topics at the Conference and his papers have always been a very instructive reading to people interested in the agricultural improvement in the C. P. and

Berar. The cultivation of long-stapled varieties of cotton in India has been eagerly looked for by the Indian cotton manufacturer for a long time past. In his paper contributed to the third Industrial Conference, Mr. Clouston in giving us an account of the efforts made by the Department towards the improvement of cotton had given us the hope that the local manufacturer will be enabled to obtain locally a larger supply than at present of the 'long-stapled varieties' instead of having to import them from America, as he is compelled to do under existing conditions. In the paper contributed next year Mr. Clouston said nothing about the long-stapled variety but wrote that 'it had been found that the best of the four distinct types of cottons which constitute the so called *Yari viz.*, *Malvensis* (which is short-stapled) was worth a considerable sum more per *Khandi* than the mixture grown at present.' Later on, in the paper read at the sixth Industrial Conference the conviction went on deepening that there was not much of a chance for the extension of long-stapled varieties of cotton because the cultivator does not always get the full market value for any superior cotton that he may have to sell. The paper now before us demonstrates conclusively how, 'even if the full market value were paid, it would be exceedingly hard to find any long stapled cotton that would compete with *rosea*, which gives a heavy yield of cotton of a kind which is much in demand.'

However much we may deplore, from one point of view, the conclusion which the results of the investigations carried on by the Department have forced upon us, from the economic point of view—from the point of view of the immediate interest of the agriculturist himself, it is more profitable for him to grow the *rosea* short-stapled variety. The reply which Lord Crewe gave the other day to the deputation of the cotton growing association which waited on him approaches the question of increasing the supply of long-stapled varieties from the same point of view. Mr. Clouston says.

'In the past far too much stress has been laid on the importance of quantity of staple as opposed to quality. In the absence of accurate

knowledge as to the outturn per acre, ginning percentages and relative values of the lint of the different races grown, the methods of improvement adopted were largely based on the requirements of Lancashire Mills. What was good for the ryot was lost sight of. After having gained a fuller experience, we are compelled to admit that, under present conditions, quantity is a more important consideration than quality, and that over nine-tenths of the cotton area *rosea* is a variety which will pay best.

The special qualities of the *rosea* which thus prove a formidable rival to longer-stapled varieties are that

'*Rosea* is a hardy variety and therefore suffers less than others from the vicissitudes of the climate and the cracking of our black cotton soil; it is the earliest, too, of all the races grown, and its seed gives the highest germinating percentage. It is capable of great improvement in its ginning percentage by plant-to-plant selection. The selected strain which is now being propagated on the seed farms has given an average of 40.3% of lint. If it were possible to substitute *rosea* for the *Katevilayti* now grown, the higher ginning percentage alone would in a normal year result in an increase in the Central Provinces and Berar of 51,000,000 lbs. of lint. This is possible and to effect that it merely requires time and organisation, as the cultivators every where are clamouring for the seed.

The trial of exotic varieties will be continued but success seems to be very doubtful owing to climatic conditions being untenable for long-season cottons.

'The rainfall of the cotton tract ranges from 30" to 45" annually nearly all of which is obtained during the first three months of the growing season, i.e., from the end of June till the end of September.

Of the exotic varieties tried up to date *buri* is by far the most promising.

'At present prices, it pays to grow *buri* in fields where *deshi* cotton is subject to wilt disease and this is being done. Many cultivators who have tried it, have found that it pays, too, when grown in the well manured *khari* soil found near the villages.'

The seed of selected strains is distributed to cultivators from the seed farms. The greatest difficulty at present is that of getting *kapas* ginned without injuring the quality of seed. Hand-ginning does not serve the purpose.

'Trials are at present being made of gins driven at different rates of speed by the Gardner Oil Engine with the view of ascertaining the

Brake Horse Power required to drive a gin at different speeds, and the extent to which the damage done to the seed at the time of ginning can be reduced by running the gins at a lower speed. Mr. Low, the Director of the Department hopes to have a well-organized system of seed farms all using the same type of ginning plant; and he has agreed to maintain a departmental mechanic who will spend his whole time in setting up these plants; in training men to drive this one type of oil engine, *viz.*, the Gardner, and in executing repairs, when necessary.'

Mr. Pitke, Prices Current Inspector, Berar, whose paper follows next gives us various details about 'Cotton Cultivation in Berar' (p. 55). The mode of sowing, expenses incurred in cotton cultivation, the various diseases to which the plant is subject have all been described in detail in this paper.

After cotton, the next important Indian textile material is jute of which India has a practical monopoly at present. Mr. N. N. Bannerji of the Bengal Agricultural Department had sounded a note of warning with regard to this most important agricultural product of our country in a paper read at the Second Industrial Conference held at Calcutta. Deterioration, of the fibre, he said, had already been visible. If the manufacturers of Europe and America did not get better stuff than what was being sent to them at present, they will look for supplies elsewhere. Attention was drawn by him to the fact that in Java, French Indo-China and West Africa continuous and in some cases successful efforts were being made to introduce the cultivation of jute. Mr. A. P. Ghosh of the Commercial Intelligence Department in his paper on 'Bengal jute and its manufactures' (p. 185) now gives some interesting figures regarding this important crop showing clearly 'how the volume of trade in jute raw, gunny bags and gunny cloth had wonderfully expanded in the course of the last thirty years.' Incidentally Mr. Ghosh brings out the interesting fact that till 1832 the economic value of jute was not appreciated. It was in this year an enterprising Dundee Manufacturer successfully demonstrated that the fibre might be used as a substitute for hemp. As with cotton manufacture so with jute it was the importation of cheap gunnies *from*

power looms that checked the indigenous Jute Manufacturing Industry of Bengal.

The third thing that has come in for treatment this year is lac cultivation. Though, we have for the convenience grouped it with cotton and jute this is not strictly speaking an agricultural product. So far as the records of the Industrial Conference go, this is perhaps the first time that the subject has been fully and adequately discussed in a paper exclusively devoted to its consideration. At the Conference held at Allahabad Mr. C. M. Patel in his paper on 'Economic Entomology' had only incidentally mentioned it and he gave figures of the annual export of lac and its value. Mr. T. R. Kotwal, Sub-Judge, Poona District has therefore rendered a service to the Industrial Conference in bringing the subject up so prominently forward (p. 175). Mr. Kotwal has studied the subject from all points of view. He has described the various stages in the life of the lac insect, he has described the present state of the industry in the Bombay Presidency, and he mentions the principal trees suitable for lac culture in the Poona District. He also points out what the Railway, Irrigation and above all forest authorities can do to give an impetus to the lac industry. Many trees along the Railway and canal lines are eminently suitable for lac culture. Besides

'there are trees in cantonment grounds and they can be made to yield revenue to the cantonment fund. The Municipalities and Local Boards own trees which they can utilize for lac propagation. In Dhulia there are Pimpal trees which yield lac yearly and the Municipality collects it through Bhils and earns a small income. It may take up the work and supply motherlac and increase the produce.'

Our local bodies may thus find in this systematic lac culture an additional source of revenue. There is a good deal of available literature on the subject and it is fully dealt with in Mr. Stebbing's monograph. Propagation of the lac insect and collection of lac are discussed fully by Mr. Lefroy, Sir George Watt, and Mr. Stebbing. There seems to be vast scope for the development of this industry in the Deccan and

Sind. The Babul tree, so ubiquitous on waste lands and canal banks, appears to be very suitable to lac cultivation. Mr Léfroy, the Imperial Entomologist observes :—

“A very important plant is the Babul (*Acacia Arabica*) which in Sind bears lac which is of great value. There could be a very large extension of lac cultivation on this plant which grows freely in very wide areas in India. On this tree especially there could be a very large production of lac on *canal banks*, on *waste land* and wherever this tree occurs. Its potentialities as a lac producer are equal to those of Ber (Bor) and there is immense scope for lands being rendered profitable that are now of little value except as a source of firewood and grazing for goats. *Babul lac* is apparently a distinct species and to start the cultivation, one must obtain the mother lac from Babul. This proposition about species does not stand the test of my experiments and will be dealt with separately. Babul lac is obtainable in Sind, Rajputana, and the drier parts of North India and is not known to occur elsewhere.”

By producing synthetic dyes the German scientific researches reduced the price of lac and checked its production in the past. There is a certain soluble colouring matter present in lac incrustations of which the latter contains as much as half its weight. Now

‘this colouring matter has a most baneful effect on shellac, inasmuch as, its presence tends to deteriorate the quality of the article. This colouring matter is known to be held very tenaciously in the crystalline deposits of the lac grains.’

Mr. Puran Singh, F.C.S., has invented a process of refining lac by the aid of woodspirit (methyl alcohol) and this process is expected to produce a greater and purer yield of shellac from crude lac than has hitherto been possible.

In the opinion of those competent to judge Mr. Puran Singh's methods ‘will not only revolutionise the old methods of manufacture of lac now followed (described in Sir George Watts' book and Puran Singh's note) but will confer a great boon on the villagers who carry on the lac industry by saving them a lot of trouble which they now take in carrying and storing the lac.’ The apparatus required for the purpose is said to be very simple both in construction and working.

— Somewhat allied to the subject of lac cultivation is the

industry of bee-keeping in India. Both are branches of Economic Entomology and Mr. M. K. Ray, B. Sc., F. C. S., State Geologist, Alwar State, has contributed a paper on the latter p. 223). 'Although the literature on bees is some thing enormous,' says the writer, 'published account of *Indian* bees is very meagre indeed.' He has described in simple language, divested of all technicalities, the habits and habitat of the Indian bees and the latest methods of bee-keeping. Mr. Ray says that 'in America, where material and labour are both expensive and honey is very cheap, it is estimated on a conservative basis that on the average a profit of Rs. 15 per colony per annum could be realized. On this basis 200 colonies, which one man can manage without any assistance would produce an yearly income of 8,000 rupees.' It could be started on a small scale and taken up as a minor industry. One may start the industry with a very small capital say even 50 or 60 rupees.

Standing on the borderland as it were between the agricultural industries on the onehand and highly technical manufacturing processes on the other is the sugar industry of India. Next after the premier Indian Industry *viz.*, agriculture, there are no questions, which more prominently engage public attention at the present moment than those connected with hand-loom weaving and the sugar industry. At the very first session of the Indian Industrial Conference, Mr. Hadi gave an account of certain improvements thought out by him which he then said had 'reached a sufficiently satisfactory stage and had stood the severest criticism that the native refiners could offer. After the Hon. Mr. Malaviya had moved his resolution in the Imperial Council, recommending heavy import duties on sugar, Mr. C. Menon, in a paper read at the third session of this Conference insisted upon the necessity of modernizing our methods of sugar manufacture. At the Conference held at Lahore both Mr. Shakespeare of the well-known sugar-manufacturing firm of Messrs. Begg Sutherland & Co. of Cawnpore and Mr. Noel Paton, Director General of Commercial Intelligence Department summed up the

principal difficulties which 'retarded any advance towards more effective methods of cultivation and manufacture.' Of all other difficulties the most serious was the universal condition under which crops were raised in India—*i.e.*, 'the division of the cultivation into small holdings.' 'With the exception of isolated tracts, the cane crop is raised in widely scattered patches and this compels the farmer to crush his cane as near the field as possible'

'The resources at present available to the cultivator for bringing his cane to the factory are bullock carts, which is a slow and costly method of transport and would never sustain a factory's requirements. A system of light tramways, following the main roads of the district and radiating from the factory for distances corresponding to the capacity of the plant are necessary if a modern factory is to be effectively and economically served with cane supplies.' The paper which Prof. Shah of Lahore read at the Sixth Industrial Conference did not carry our knowledge of the subject much further but, in a general way insisted upon the co-operation of the expert agriculturist, the chemist and the Engineer and the financier if sugar industry were to be a success in India. In the meanwhile, a pronouncement on the whole subject which may be considered in a large measure authoritative has been made by a series of resolutions adopted with reference to it at the last, that is, the seventh annual meeting of the Board of Agriculture in India. The sugar industry formed subject No. XII on the programme and a special sub-committee reported on it. The resolutions adopted were—

'That the Board cordially endorses the position taken by the I. G. of Agriculture in India, *i.e.*, his note to the Government of India, that the sugar industry deserves the assistance of Government'.

'That the Board accepts the recommendation of the committee regarding the employment of a sugar Engineer'.

'The Board accepts the recommendations of the committee regarding the programme of Agricultural work, laying stress on the location of sugar stations only in sugar tracts' &c.

'The Board accepts the recommendation of the committee that all possible facilities should be afforded to capitalists, whether small or large who are prepared to undertake the industry'.

'The Board recognises the value of the action already taken by some Local Governments (C. P. Government for instance) to reserve certain areas of suitable land for the establishment of central factories and hopes that similar action may be taken, where possible, by other Local Governments and that grants of available land may be made on favorable terms'.

'The Board recommends that Local Governments should be empowered to assist pioneer factories, by subsidy, by taking deferred shares, or by such other methods as may be appropriate'.

When we consider the composition of the Board of Agriculture in India we may hope that the recommendations backed up by their influential support will carry weight with Government and will soon be carried into effect. In the meanwhile Mr. R. S. Hiremath, L. A. G. of Poona and Mr. Mukhtiyar Singh of Meerut in their respective papers on the 'the sugarcane and sugar industry in India and other countries' (p. 86) and 'sugar industry' (p. 144) have laid before the public a mine of useful information which will no doubt tend to keep up the interest of the general public in this most important subject. It is impossible to compress within the short space available here all the interesting information which Mr. Hiremath has gathered about the various sugar producing countries. Before coming to the figures on cane cultivation and sugar manufacture in India Mr. Hiremath has given details of about 18 other sugar producing countries.

'In order to find out the defects that lie at the bottom of this we cannot do better than study the conditions of other cane-growing countries from every possible direction. Though the statistics of cane and sugar production of any one place cannot be taken as affording an index to the capabilities of any other place on account of the varying conditions necessarily existing, much information of a comparative nature may still be gained by presenting such details in a collective form.'

The sugars of Java and Mauritius bear the heavy burden of ocean freight from 12 to 15 shillings per ton and the Imperial duty of 5% and yet they hold their own against the sugar manufactured in India. The information collected by Mr. Hiremath, about the agricultural methods adopted for growing cane and the manufacturing processes in the various countries, contributing so much to the economy in cost of production must therefore be of immense interest to all. With regard to Indian sugar the best sugar authorities maintain.

"were modern machinery installed in the place of the antiquated conglomeration of wheels and rollers at present to be met with, the sugar production of India could be doubled with little or no difficulty. Of the world's total output of sugar, namely, 8,840,000 tons of cane (and 6,940,000 tons of beet) India is responsible for 3,000,000 tons or nearly 39 per cent. of the whole. Were modern machinery instead of the ancient one utilized, India could produce more than one-half of the world's supply. Neither need the area of cultivation be extended by a single acre ; but, on the other hand, were the existing fields of cane properly manured and scientifically cultivated, the product would be 100 per cent. above what it is to-day and with a very much higher percentage of juice."

Central sugar factories situated in the midst of cane-areas are the things required to modernize sugar production. The conclusion arrived at is the same as that drawn by Mr. Noel Paton before.

'On account of the scattered distribution of the cane crop, the large factories of the type existing in Java and Hawaii have a chance of success in a limited number of places ; but there is no reason why a small and efficient plant working from 100 to 200 acres of cane in the season, and employing vacuum pan evaporation and improved methods of clarification, should not succeed in many places. In all countries where cane is produced on a competitive footing factories are put in the centre of sugar-cane tracts. The cane will be as near the mill as possible and so will not deteriorate before reaching the rolls. Good roads leading to factory, a railway siding hard by, and a good supply of water either from canal or river are also taken into consideration before setting up a factory.'

Failures of sugar-factories in Bengal and U. P. are attributed to want of expert management. To remedy the defect

'there should be sugar schools of the type of Louisiana State University under the care of practical and experienced people to spread the technique of growing cane and manufacturing sugar. Germany the most scientifically trained of all the sugar producing countries has long had sugar schools.

Molasses the principal bye-product of sugar industry may be utilized for manufacturing alcohol and for the making of potash—the last residue that remains after alcohol is distilled off, thus adding to the profits of the main sugar industry.

Mr. Muktiyar Singh approaches the question from another point of view (p. 144). He dismisses the factory system of sugar manufacture as unsuitable in the present conditions of Indian agriculture and confines his attention to small improvements in the indigenous methods of cultivation and manufacture. He points out various defects in Khan B. Hadi's improved system of sugar refining and shows how they might be remedied.

Like the Indian sugar-industry, oil-pressing also occupies a position midway between agriculture and the manufacturing industries proper. Dr. H. Mann Principal of the Poona Agricultural College, in his paper on 'Oil pressing in the Bombay Presidency' (p. 211) has given the results of his investigation in that province. So far as it goes, we find in this paper too the same stamp of thoroughness, earnestness and lucidity which we have learnt to associate with whatever investigation Dr. Mann taken in hand. His paper is in the nature of a report and he has therein dealt with oil-pressing chiefly as a large-scale industry. Dr. Mann sums up the results of his investigations thus.

'The oil-pressing industry is in its comparative beginnings. Its future depends first and foremost on the increase in the local demand for oil. In the Bombay Presidency, we have already a demand for cake which takes, as manure all the castor cake produced, and more-and which would compete, if the price were only a little higher, with the export demand from Liverpool. This rise of price seems certain to come and

then the increase in the demand for oil will be more than ever the dominating factor.'

The various lines of industrial and agricultural activity that are being pursued at present in India present a fascinating opportunity for a study in parellisms between conditions obtaining in India now and those that prevailed in England centuries ago. The study is interesting not only to the dilettante student of economics but oftentimes those practically engaged in the advancement of these activities may carry away very useful lessons for their guidance from such a study. Mr. C. E. Low, Director of Agriculture in C.P. and Berar has embodied the results of such a study in parallelisms, (p. 1) in a paper bearing the same title. The whole paper is so interesting—it must be read in the original to be properly appreciated; but the reader has to bear in mind 'that the illustrations of parallels in India to similar phenomena in England are taken entirely from the only part of India with which Mr. Low is personally acquainted *viz.*, the Chattisgarh Division.' 'There are important *differences*, as well as important resemblances—often times the former are the less obvious.' 'To take a single instance, from the earliest years of its history, the rural *districts* of England have contained a very effective form of self-Government.' But in India 'any system of autochthonous administration, outside the village unit is what we do not find.'

The conclusion drawn from various facts emerging out of this study is 'that all nations have to pass through more or less the same processes of evolution, and England of 600 years ago was very like, allowing for differences of climate and national character, the India of to-day.' We may or may not agree with another conclusion drawn from the same facts *viz.*, that there is not much difference in the happiness of a nation at different periods of its growth—the spiritual East may readily agree with this view though the aggressive materialistic occident may not. But the writer is not prepared to draw the obvious conclusion from the assumption of its truth *viz.*, that we should give up all attempts at progressive industrial development.

'Pauperism in India, which is bound to be the result of a large population entirely divorced from all connection with the land, and drawing their livelihood from the fluctuating demands of trade, will be a vastly more difficult problem even than in England, where we have hardly as yet begun to solve it.'

But we are not to recoil, therefore from the path on which our feet have been set since this world began 'the power that made this world and all that is in it, is fulfilling its own purpose in ourselves, for the benefit of the whole created universe.'

Incidentally in the course of his paper Mr. Low describes how 'it was the result of the policy of her kings, that the wool trade laid the foundations of her present industrial position. The powerful weapon of protection was employed, first to raise the price of the new product, and next to prohibit its export, and thereby build up a trade in cloth.'

In the present state of British opinion in England and India it is natural for Mr. Low to hesitate to draw the obvious lesson from the facts quoted above. He declines to enter into the question 'whether a corresponding line of protective policy would have equally beneficial results under modern conditions or not.' The difficulties in the way of instituting a system of protective tariff in India have been, however, fairly and fully stated by Mr. Findlay Shirras. He is not one of those who would invest the free trade doctrine with any special sanctity, 'as if it were an eleventh commandment added to the Decalogue. But,

'there are many difficulties as for example, the length of the period for such protection, In India one industry may require even 30 years, while another but 15 or 20. Moreover, it is most difficult for a Government to use the argument fairly and honestly. Behind a tariff wall, there will be a number of industries which can never exist without it, and it is a far wiser policy to let these die than be a burden. Protection is, as the term itself implies, and as the American tariff on woollens, and the French and German agricultural tariffs have demonstrated too often, a policy for the weak and not for the strong. Very often, the motive power behind a tariff is a chronic clamour of self-seeking classes without any spirit of philosophic contentment !'

We may even agree with Mr. Shirras about the risks, and difficulties mentioned by him attending the domestication of new branches of production and endorse the opinion that protective tariffs alone will not avail much.

If a country like India is agricultural and has no large and important classes of artisans and factory workers, the skill required for commencing any kind of mill will be exceedingly difficult. Competition with established foreign rivals will be impossible in spite of the fact that the country has great natural advantages. But notwithstanding all this and granting what little truth there may be in all these considerations, Indian opinion would hardly feel convinced that its infant industries will not benefit by a wisely devised impartial system of protective tariff.

As the key note of all permanent agricultural improvement there is no subject more important than the organization of co-operative credit among the agriculturists. Mr. Crosthwaite, Registrar of Co-operative Credit Societies, C.P. and B. records the history (p. 417) of the progress of the movement in the province with which he is connected. The first village society in the C. P. was found on 20th June 1905 with 20 members and a capital Rs. 240. At the end of 1911, 'it will be found that rural societies number about 500, that several new central banks have been formed, that industrial societies have commenced work, that a great advance has been made in the case of existing Urban societies, that co-operative capital has again increased very largely, that our list of workers is longer, and that the question of resources has been solved by the formation of the Provincial Co-operative Bank with a capital of Rs. 5,00,000 which has already been over-subscribed by the leading men of the Provinces.'

In spite of the record of progress evidenced as above there are still sceptics who doubt if the movement will ever really succeed. But 'the sceptic has his uses. He serves as a thermantidote for enthusiasm that is too hot and not a few of the sceptics themselves have assumed the more profitable role of co-operators now. 'In 1904 there were no workers in the field. At

present there are about 50 non-official gentlemen taking an active part in organization.'

Amongst the papers that may be said to belong more to the general study of Indian Economics than of any specific industry or branch of trade, may be mentioned the paper on 'some aspects of Indian Commerce and Industry' by Mr. G. Findlay Shirras of the Imperial Financial Department (p. 395), Prof. Kale's paper on 'India and the Imperial Preference' (p. 245), Prof. Sammadar's paper on 'Requisites of Production' (p. 196) and Mr. Bullav's on 'Gold Standard in India' (p. 230). It would be more convenient to deal with the two latter first. Mr. Bullav gives a history of the currency policy of the Indian Government and concludes that

'It is a permanently beneficial reform, intended to place India in her monetary and currency matters on an equal footing with the western countries, so that none can drain her on account of her depreciated currency but that she may acquire and retain gold to facilitate her transactions in the western markets.'

He has explained how the currency policy of the Indian Government has operated on the whole.

'If the gold standard were not adopted, there is no doubt that the exchange would have fallen to at least 1s. per rupee or Rs. 20 per sovereign. In that case we would have had to pay Rs. 20 for each sovereign worth of European goods. But the exchange being at 1s. 4d., we have paid Rs. 15 for that. We have imported from 1900 on an average 100 crores rupees worth of goods or goods worth £100/15 crores. So an yearly average saving from 1900 is $(100/15 \times 5)$ rupees or about 33 crores a year. Rs. 5 being the saving on goods worth a sovereign. Similarly in their remittances to the Secretary of State the Government of India has gained Rs. 5 per sovereign, so to say. Sir David Barbour guessed the gain of the Government to be 70 or 80 millions sterling.'

Prof. Sammadar, dealing with the three requisites of production in India, Land, labour and capital says with reference to Land, quoting Sir J. Strachey, that exclusive of Bengal for which there are no statistics, there are said to be in India some 80,000,000 acres of unoccupied land fit for cultivation—an area exceeding that of the United Kingdom,

In every country Industrial activity has been preceded by agricultural activity. In India also unless there is increased agricultural activity the Industrial revolution which has already begun will not attain adequate success. There are however some inherent difficulties in the matter of agricultural development which must be reckoned with.

Our holdings are small and our agriculture has to be carried on, on a small scale. Production on a large scale which has its advantages cannot be resorted to. However according to Mr. Moreland, Director of Agriculture U. P. it is problematic whether the aggregation of small holdings into one big compact whole would at all lead to increased production.

With regard to the supply of labour K. B. Bezouji of the Nagpur Empress Mill, himself a great employer of labour pleaded for an organization of the recruitment of the labour force.

' There would seem to be no room for doubt, that there are immense potentialities for a plentiful supply of comparatively cheap labour in numerous congested areas. Only, it needs sustained and organised efforts to coax it to leave the paternal home where it half-starves, and migrate to industrial centres affording more lucrative pursuits.'

The wages of both skilled and unskilled labour are so various in different parts of the country that if earnest endeavours are made it should be quite possible to tap labour from congested areas. An able officer deputed by Government to make inquiries with regards to the prospects of labour supply from the U.P. says: "There would still seem an enormous reserve of labour in the congested districts of the United Provinces to draw upon and there need be no apprehension at present that the supply is likely to be exhausted."

From labour we turn to the third requisite of production viz., capital.

The provision of cheap capital is very much the most important improvement you can suggest in any branch of industry or art. It is the condition precedent of improvement of all other kinds.

Go among the cultivators themselves and ask each man what it is he wants to make a larger income out of his holding. Every answer is a request for more capital in some form or other. In a resolution recently issued by the C. P. Government it was stated.

While on the one hand there is so much demand for capital one former Viceroy estimated that our hoarded wealth is about 825 crores—a considerable part of it is locked up in the shape of jewels and ornaments. Only a very small part is available for industrial development.' In the meantime foreign capital is exploiting Indian resources. It is not the employment of foreign capital *per se* that is objected to. It is the employment of foreign capital in a way which carries away interest on it as well as the profit in wages in their higher form that is so objected to. As Sir Vithaldas said :—

'When we turn to the petroleum industry in Burma, the Gold mines of Mysore, the coal mines of Bengal, the tea and jute industries, the carrying trade by sea and the financing of our vast foreign trade by foreign banks we come upon a less favourable aspect of the question of the investment of foreign capital.'

Referring to the petroleum industry of Burma Sir T. Holland Late D. G. of Geo. Survey of India observed,

'The one regrettable feature is the fact that the capital required to drill the deep wells has been raised in Europe and the profits consequently have left the country. In the petroleum industry, as in so many other enterprises of the kind, India will continue to pay an unnecessary and undesirable tax as long as those in the country who possess money will not risk their reserve fund in industrial purposes.'

Prof. Kale's views on India and the Imperial Tariff reform are well known to readers of Indian periodicals. They are the views of all those who have devoted any attention to the study of the subject. "Neither the Government of India nor Indians qualified to advance an opinion on such a subject will acquiesce in a fiscal policy which holds out no substantial advantages to this country. In the words of Prof. Lee & Smith 'should Great Britain adopt protection she

must honourably face the consequences of her conversion and allow to India the right to follow in her footsteps.' In other words India should have complete fiscal freedom.

Mr. K. S. Narain Rao writes with the fervour of an enthusiast about the Industrial potentialities of the Vizagapatam District (p. 355). It is a sort of an industrial survey of the District and if similar industrial enthusiasts could be found for the different Districts of India, it will assuredly lead to a wider dissemination of knowledge about the industrial needs and possibilities of the various tracts. Vizagapatam itself is said to be the natural port of the Central Provinces. At present it is a mere mercantile harbour. When the Raipur line is pushed on beyond its present terminus at Parvatipore and the Vizianagram Raipur section of the B. N. Ry. is completed the economic gain to the District would be immense—it can hardly be overestimated, Mr. Narain Rao thus sums up the results of his inquiry into the industrial possibilities of the District :—

"I have shown you in the course of this paper the immense potentialities of the district for industrial, agricultural and mining enterprises. I have shown you that there are many square miles of new country to be occupied by an industrious population now labouring beyond the seas for the prosperity of other countries. I have shown you that the district has the materials for the establishment of successful sugar, jute, paper, pencil, match and candle factories. I have laid before you a scheme for the opening of a number of chemical industries. I have proved by facts my statement at the beginning of this paper, that the district has the potentialities to supply many of the necessaries and luxuries of man".

Prof. S. R. Davar, Principal of a College of Commerce in Bombay conducted by himself in his paper (p. 348) insists upon the thorough grounding which our bankers, merchants and financiers require in the technique of trade and commerce. Mr. Davar points out how

"some fifteen years ago the London Chamber of Commerce took the lead by appointing a special committee to formulate a Scheme of education best suited to the rising generation of businessmen. The scheme thus recommended is the one under which the examinations in the various

subjects of Commerce are held yearly all over the World by the London Chamber, where thousands of candidates appear."

The need of at least one Commercial College in all big business centres is now admitted on all hands. The Universities are being pressed to institute degrees in commerce and very recently we saw a project for a Commercial College in Bombay matured by some of the most leading men of the place. With the new turn for investments in Industrial concerns India is evincing it is much more necessary now that a sound Commercial education should be imparted to at least a few so that the confiding public may cease to be imposed upon by the many rotten Joint Stock Companies which are so freely advertised nowadays. Mr. C. G. Menon's, paper on 'the influence of science on industry and commerce' (p. 421) is devoted to pointing out the need of a College, of Technology for imparting instruction in all branches of mechanical and technical industries.'

Mr. Saklatvala of the Empress Mills, Nagpur in his paper 'India's Educational obligations' (p. 336) puts in a plea for the now defunct Elementary Education Bill. To the charge that the enactment of such a measure would be a drastic reform and premature at the present time his reply is that moderation is no doubt commendable but too often moderate reforms mean only a temporizing with present abuses. The universal diffusion of elementary education would give us not only better citizens but better ploughmen, better weavers better bricklayers.' With regard to the sending of Indian students for technical instruction abroad, Mr. Saklatvala puts forth once again the suggestion which has often been made before by observant critics of the practice. Very often it has been found that they are able to achieve nothing after their return.

'It would perhaps be a far better policy to employ the money now spent with but little gain, in calling out experts to India to teach different industries. Their superior knowledge and varied experience would soon enable them to master local conditions and they can then import useful knowledge which is bound to produce beneficial results.'

In illustration of the beneficial results expected to flow from the adoption of the above policy Mr. Saklatvala instances the example of the Tata Iron and Steel Works at Sankchi where a highly efficient staff of Indian industrialists is under training under the most expert European and American supervision.

Rao Sahib M. Ramrao Garu, Conservator of Forest, Travancore in his 'Note on the prospects of establishing Match factories in Southern India' (p. 486) summarizes the contents of an important monograph on the 'Prospects of Match Industry in the Indian Empire' published in the Indian Forest Memoirs series by Mr. R. S. Troup, F.C.H., the Imperial Forest Economist. It is an admirable summary of a book running over many chapters and as it is very probable that the book itself is beyond the reach or has not been perused by those interested in the match industry, it is a distinct service to have its contents presented in a succinct form, so that they may attract the attention of such capitalists as may wish to invest their capital in this industry. It will be remembered that Mr. Troup himself contributed a short paper on 'Indian woods suitable for match manufacture' to the Fifth Indian Industrial Conference held at Lahore. The inference drawn from the Survey of the situation is nothing new.

'Considering that India is one of the largest forest-owning countries in the world with a much larger number of woody species of trees than any other country, it is indeed a matter for surprise and humiliation that she should depend on other countries for her matches.'

In respect of the existing match factories of which there are eight or nine most of them are comparative failures because of the 'wrong choice of factory sites' and 'the absence of expert advice.' As regards the machinery employed in the manufacture though the Japanese machines cost only one-third to one quarter of the German machines, yet the success of a factory on the Japanese model 'depends to a large extent on the

persistent efforts of the manager who works hard along with his workmen. It is however problematic how far 'originality on the part of manager and energy on the part of workmen' so necessary to ensure success in factories on the Japanese model can be relied upon in India. All the probabilities seem to point the other way.

As regards the suitability of Indian woods for match manufacture, Mr. Troup sent 70 different kinds of Indian woods to Mr. A Roller of Berlin to be tested, of which as many as 51 were reported suitable for matches in varying degrees. Out of all the variety called '*Bombay Malabricum*' seems to be the most suitable for match manufacture, and all possible match-factory-sites having been selected, Mr. Troup demonstrates from his careful calculations that 'the systematic formation of plantations of this variety in close proximity to these sites is likely to be highly profitable to Government and great benefit to the match industry in India.'

In dealing with possible match factory-sites in India, with regard to the possibility of establishing match factories in Southern India all the conservators in Southern India seem to have given it as their opinion that there are few or no chances of establishing any factories in their circles successfully except perhaps along the Godavari river and possibly at Tellichery and Calicut on the west coast and Udumalpet in the Coimbatore District—even the last three being considered by the Conservator of Forests, Southern Circle as 'unlikely to be suitable.'

The main purpose of Rao Bahadur Ramrao's paper is to challenge this statement as regards the prospect of match industry in Southern India. It is somewhat surprising says Mr. Ramrao 'that notwithstanding the richness of tree species both in variety and abundance all along the western ghats, it should be thought that there is no scope for establishing match factories there successfully'

Rao Bahadur Ramrao after carefully going into the question of facilities for transporting timber to the factories and other kindred considerations gives his deliberate opinion that

the forests of South Canara and Malabar and especially the forests of the two South Indian Native States, Cochin and Travancore abound in numerous kinds of soft woods suitable for match manufacture. The demand for soft woods being extremely small it should be possible for the Forest Departments of the Native State to deliver woods suitable for matches at an average price of 4 as. per cubic ft. at places suitable for match factories. Rao Bahadur Ram Rao especially mentions 4 sites in Travancore because of their close proximity to perennial rivers, to the Railway, to extensive forests from which an unfailing supply of timber in a green state can be obtained, and to the sea ports of Quilon and Tuticorin, which help not only to get in supplies of chemicals, &c., from Europe but also to export matches for maritime trade, while the Railways will facilitate transport of finished matches to various parts of South India.

One of these, *Meenmulli*, is said to be an ideal place for establishing a match factory. The conclusion drawn from a thorough examination of all existing facilities is that

there need be no doubt whatever as regards the certainty of a steady supply of wood in Travancore and Cochin at rates not exceeding 4 as. per c. ft., for at least 20 years to come from the existing natural forests.

Further, should the supply from the existing natural forests run short, it is said to be quite practicable to rear plantations of suitable woods.

The forcing tropical climate, the heavy rainfall, and the admirable suitability of soil, and other conditions for the rapid growth of such woods exist along the West Coast, and the cost of such plantations will be comparatively small as pointed out by Mr. Troup.

Taking the quantity of the annual Indian Consumption of matches and the possibilities of a transfrontier land trade alone Mr. Troup in the paper he contributed at one of the previous Conferences had calculated that there was room in India for about 70 large size match factories of which there now exists hardly a single one. The half a dozen factories that exist are both in point of outturn and quality most unsatisfactory. Let us hope that the possibilities of match factories pointed

out in this paper will induce our South Indian industrialists to plant them along the West Coast at suitable places.

Mr. Alakh Dhari formerly of the Amballa Glass works, contributes a very exhaustive paper on "Ice manufacture," (p. 254) which is more of the nature of a treatise on the subject than a short paper for the Conference. Mr. Alakh Dhari has dealt with the subject from all possible standpoints. He describes the general principles of Ice-making and their practical application to industrial purposes. Those interested in Ice manufacture will derive very valuable information and help from this paper.

In his paper on "Colonisation of Mesopotamia by Indians" Mr. P. Peter Pillai, of Madura, rigorously criticises the Government policy towards Indian industries and takes the people of the country to task for their apathy in this matter. His plea for the colonization of Mesopotamia by Indians deserves a very careful consideration at the hands of all thoughtful enterprising people. Mr. Pillai suggests that a deputation of some three or four gentlemen should be sent to Mesopotamia to make local investigation for the purpose of arranging about colonisation of a tract which according to expert opinion is able to "support 500 times as many inhabitants as it actually contains at present."

SUMMARY OF PROPOSALS AND SUGGESTIONS.

A.—The work of the Conference.

1. The great aim of the Industrial Conference ought to be the infusion of new life into such industries as are not dead, the resuscitation of such as are dead but are useful under present conditions, and the introduction of new ones. (*Hon'ble Mr. M. B. Dadabhoy*, p. xii).
2. In the matter of national education the efforts of Government should be supplemented by those of the public. Here at least there is field for conjoint action and for wholehearted co-operation between Government and the people. This Industrial Conference too ought to do its part of the work and to contribute its mite. (*Ibid* p. xxv).

Investigation.

3. It is the conditions favourable to the sale of our manufactures that demand examination. (*The Honorable Mr. M. B. Dabhaboy*, p. xxvii).
4. It is necessary that a commission of a few experts must go about the country, study and collect information as to the existing methods of cultivation, implements used and manures employed and put the best of these methods and practices into operation and introduce them in backward Districts by modifying and adapting them to the existing conditions of the place where they are to be introduced ; other practices and methods which do not obtain here but which will be equally useful in this country may be borrowed from abroad, provided the cost is not prohibitive. (*Mr. V. V. Jogiah*, p. 81).

Education.

5. Equally important with sufficiency of capital is the diffusion of expert and up-to-date industrial knowledge among the people. (*Hon'ble Mr. M. B. Dadabhoy*, p. xx).
6. The scope and object of a well-devised system of technical education should be to utilise and improve the inherited skill of the Indian artisan, to stimulate increased production by the introduction of improved labour-saving appliances, to train the people in mechanics and mill management, and to disseminate such industrial knowledge as would divert the trained activity of the nation into new and profitable industrial channels. (*Ibid*, p. xxi).
7. Schools of design at selected centres should be very helpful. Technical institutes and industrial schools must likewise be started all over the country. Workshop apprenticeship, favoured by Mr. Cumming, will be specially valuable, providing as it will be practical knowledge which India lacks so much. But a comprehensive scheme of technical education must provide for the establishment at suitable centres of Technological Colleges and Research Institutes for the impartation of thorough training in the higher branches of industrial science. (*Ibid*, p. xxi).
8. Leaflets in easy vernacular, setting forth the uses and advantages, the working expenses, the method of working, the productive power, etc., of heavier plant, should be distributed freely among the people. They have a valuable educative influence, and any system of industrial education, to be effective and popular, should provide for them. The cost, even if large, should be incurred in the industrial interest of the people. (*Ibid*, p. xxiii).

9. We must have Primary Education all over the continent to derive the fullest benefit from Technical Education. Primary Education is as mordant or grounding. And in a country like India such education, to be effective, should be free and gradually compulsory. (*Ibid*, p. xxiv).
10. In the matter of national education the efforts of Government should be supplemented by those of the public. The rich cannot put their wealth to nobler use than by spending it for the support of education. (*Ibid*, p. xxv).
11. Modern India should learn and value the Dignity of Labour, the one great idea which lies at the root of American greatness. We must rebuild society in full in recognition of the new gospel (*Ibid*, p. xii).
12. All Indian Businessmen should receive in one form or other a specialised Commercial Education. (*Prof. S. R. Davar*, p. 354).
13. If India should ever take a prominent place in Natural Science and Technology based on it, she must popularise scientific knowledge and begin to manufacture things herself. (*Mr. C. Gopal Menon*, p. 435).
14. There is, the want of a College of Technology for imparting instruction in all branches of mechanical and chemical industries and we trust that the suggestion for the establishment of such a college would be soon carried out. (*Ibid*, p. 435).

Labour Supply

15. The anti-Indian prejudice appears to be spreading. It is better, therefore, the Indian emigrant should return to the motherland, and help in the upbuilding of its industries. It is far better, far more dignified to sweat at home than to drudge abroad. The people

- might themselves refuse to go to distant and inhospitable lands. It is within their power. (*Hon'ble Mr. M. B. Dadabhoy*, p. xxvi).
16. Earnest endeavours should be made to "tap" labour from congested districts. (*Prof. J. N. Samaddar*, p. 204.)

Miscellaneous

17. The rich and fertile District of Vizagapatam, abounding in mineral wealth and possessing other natural advantages, with potentialities to supply many of the necessaries and luxuries of man, should be properly exploited by our countrymen (*Mr. K. S. Narain Rao*, p. 373).
18. Indian princes and other wealthy employers of Indian artisans should endeavour to grasp the economic and artistic bearing of the architectural question, and cease to leave their artistic consciences in the keeping of European experts and non-experts, and help the Indian Master-builder to come to his own again. (*Mr. E. B. Havell*, p. 394).
19. The raw produce must be converted into manufactures here in India, and the surplus products of Indian factories sold abroad.—(*Hon'ble Mr. M. B. Dadabhoy*, p. xxvii).
20. Market pushing is another essential factor of industrial success which, so far as the inland market is concerned, is quite within the province of commercial bureaus. But the main part of the work must be done by the manufacturers themselves. The time has come when the Western methods of exploitation of the market through travelling agents must be adopted by manufacturers. (*Ibid*, p. xxxvi).
21. The conditions of manufacture and sale should be settled by Chambers of Commerce, with centralised powers of direction (*Ibid*).

22. Colonization of Mesopotamia, where famine will be unknown will be a great relief to the famine and poverty-stricken people of India.—(Mr. P. Peter Pillai, p. 334).

Capital and Co-operative Credit

23. Patriotic as much as official effort should be directed towards the introduction of the co-operative system among cottage manufacturers. (*Ibid* p. xxxvii).
24. London rules the World's finance, and India should have under normal conditions special facilities for raising loans there. What India wants today is abundance of foreign capital, not wholly to be employed by foreign manufacturers, miners and merchants for their own profit and the enrichment of their own countries, but as *loan* for application to the various industries by Indians themselves. The Government of India alone can secure to the country foreign capital on these conditions. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xvii).
25. The suggestion made by my Hon'ble friend Sir Vithaldas Thackersay from this platform that a percentage of shares in companies floated by foreign capitalists should be reserved for Indians, is certainly not extravagant. (*Ibid*, p. xviii).
26. The people should have the option and the right of buying up the existing industrial concerns owned and managed by European capitalists on terms and conditions that might be settled by Government. (*Ibid*, p. xviii).
27. Active suasion by local officers and Government guarantee within reasonable limits to Indian concerns and periodical audit of accounts should provide the most effective cure for the proverbial shyness and immobility of Indian capital. Loans can

also be advanced by Government to promising concerns with advantage. The relief suggested by Messrs. A. Chatterji and J. N. Gupta in respect of provincial concerns should be systematised, and should form a part of the industrial policy of the Government of India, instead of being the result of the individual efforts of sympathetic officers. (*Ibid*, p. xix).

28. Grant to industrial companies should be the first charge upon their States as agricultural loans and Tukkavee advances are given to ryots; in the same way industrial loans and advances might with advantage be made on proper securities. The Sovereign princes themselves and their wealthy and influential relations in public and private can take part in the industrial development of their respective provinces, with their resources. (*Mr. P. Peter Pillai*, p. 327).
29. What the co-operative movement most requires is a large number of zealous workers. (*Mr. H. R. Crosthwaite*, p. 417).

Industrial Bureaus

30. Commercial and industrial bureaus must have a definite place in a well-devised system of industrial development. The country needs guidance and advice more than active help in management. Properly organised bureaus can give us this advice with the help of bulletins and reports which should be published in Vernaculars. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxv).

Fiscal Policy

31. Experience shews that protection is absolutely necessary for the development of the infant industries of

- a country. The people should be supported in their attempt to provide the protection which, from its dependence upon a pronounced Free Trade country, Government cannot sanction immediately. As Prince Bismark said : " Let us close our doors awhile." If the ports cannot be closed, let the markets be closed by inoffensive, lawful and constitutional methods. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxvii and xxviii).
32. Prohibitive duties upon Indian exports imposed in foreign countries must be abolished. (*Ibid*).

Agriculture

33. The institutions suggested above should be largely supplemented by demonstration farms and factories and demonstration lectures by peripatetic instructors. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxii).
34. The ideal of Asram should be revived. The cultured people should live in farms by their honest labour enjoying health of body and mind. They should use their spare time in intellectual and spiritual culture and thus follow the footsteps of the Rishis of holy memory.—(*Mr. H. C. Das*, p. 43).
35. An agricultural association composed of the prominent members of the country should be formed which will spread agricultural knowledge throughout the length and breadth of the country and by direct instruction and distribution of literature find out means for creating a class of educated farmers. (*Ibid*, p. 54).
36. If we want to improve the lot of our cultivator, we must bring within his reach capital, the supply thereof being made promptly and on terms which the cultivator can accept. (*Mr. V. V. Joghiah*, pp. 81, 82).

37. It is absolutely necessary, if the ryot is to be saved, from excessive assessment that some sort of permanent settlement should be granted to him and the period of revision should be increased at least to 60 years. (*Mr. V. V. Jogiah*, p. 84).
38. What we ask our Government and the landed aristocracy to do is to give our ryots a sound elementary education, to disseminate broad-cast a knowledge of agricultural science and improve methods of cultivation. We want them to found scholarships for our young men. We want in every District, in the Head Quarters of the Collector, a branch of the agricultural department under the directions of Agricultural Superintendents with a number of Inspectors under them. We want model farms on an extensive scale to be opened in the Head Quarters of each Taluq with an Agricultural Museum attached thereto, which is accessible to the agricultural population. We want tables containing an analysis of soils of each Taluq, so far as practicable, to be prepared and kept in these Museums, so that those ingredients of the manures which are wanting in them may be supplied. We want the Inspectors under the supervision of Superintendents to establish small model farms in rural centres, make experiments, distribute leaflets to the ryots in vernaculars, and lecture, in easy language which they can understand, the advantages of improved methods and demonstrate to them the benefits thereof at their very doors. We want the irrigational facilities to be greatly increased. (*Mr. V. V. Jogiah*, pp. 85 & 86).

Cotton Industry

39. Forty-four lacs of rupees paid throughout India in

1910-11 prove a heavy burden ; it is meet Government should repeal the Excise duty on Indian Cotton at an early date. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxiv).

Sugar Industry

40. The grievance of sugar manufacturers, is that they have not got proper facilities for the manufacture of industrial alcohol. This is a valuable by-product which enhances the value of sugar manufacture. Liberal concessions in this direction will certainly improve the prospects of Indian sugar. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxiii).
41. There is no need to go outside India for good varieties. What is wanted is the introduction of these good varieties and good methods into those parts, particularly the North-Western Provinces and Behar, which Provinces it must be recollected, include much the largest area under cane of any provinces of India. (*Mr. R. S. Hiremath*, p. 123).
42. Factories will work successfully and make substantial profits if they are run on co-operative basis. (*Ibid*, p. 127).
43. The cane juice should be boiled as soon as it is available from the mills. Lime water in a small quantity should be used in each case. If the juice be of poor quality and the crystals be very small a small amount of Masajee and Sajabhamasree water be used after taking off the scum. This will increase very much the power of crystallisation and unite the small crystals into big ones. Crude potash sajji be used in small quantity. The test of knowing whether sufficient defecation has been effected is that the color of the scum be quite white. (*Mr. Mukhtar Singh*, p. 169)

Other Industries.

44. The excellent results attending the efforts of the National Fund and Industrial Association of Madras for the improvement of the local handloom industry by demonstration by touring agents at different centres of the working of improved handlooms, should be suggestive of similar action for the improvement of the other industries, and the introduction and popularisation of improved methods. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxii)
45. Salt is another industry which would receive considerable impetus from a more sympathetic treatment. (*Ibid*, p. xxxiv)
46. The effort of the Government and the patriot should be to devise means for increasing the productive capacity of the indigenous weaving industry without destruction of its present character, or impairing the fine qualities of the hand weaver. (*Ibid*, p. xliii)
47. The present very insignificant *revenue* from lac as a minor forest produce can be increased by the forest, irrigation, and Railway departments of Government on the lines suggested by Mr. Stebbing. (*Mr. T. R. Kotwal*, p. 187).
48. Since by the process of lac refining pure shellac can be manufactured from all forms and varieties of crude lac, and since the lac insect can live on a variety of different trees and is found throughout the whole of India, there appears to be no reason why its cultivation and propagation on scientific lines should not be extended wherever it is possible. (*Ibid*, p. 192).
49. 'One great advantage of Bee-Keeping is, that it could be started in a small way with very little capital—

- about 50 or 60 rupees—and the business could be rapidly built up, making the bees “paying their way” ‘Another great advantage is, that Bee-Keeping may be taken up as a minor industry. (*Mr. M. K. Ray*, p. 229).
50. The preservative value of artificial cold by the use of Ice has only to be brought to the notice of the firms dealing in commodities which fall a ready prey to the ravages of time and climate, in order to commend itself to their earnest attention. (*Mr. Alakdhari*, p. 310).
51. Really speaking, there is no part of an Ice plant which cannot be made in India. If larger manufacturing firms of the standing of Burn & Co. of Calcutta, have not yet turned their attention to the construction of this class of machinery, it is probably due to the general ignorance about detailed information as to dimensions, etc., of the different parts of the machinery. But with the increase in demand a spirit of investigation will, it is expected, naturally assert itself. (*Ibid*, p. 311).
52. No attempt has yet been made to manufacture ferromanganese. Again nothing has been done in regard to the manufacture of sulphuric acid on a large scale, as everyone knows that sulphuric acid is the key to most economic and to many metallurgical industries. (*Mr. G. Findlay Shirras*, p. 415.)
53. A great deal is to be done in the utilisation in India itself of raw materials, such as oil-seeds which are utilised in Europe and America for the manufacture of various articles of commerce. (*Ibid*).
54. The raw materials for paper-making are available in the country though not in an exactly accessible form. Large supplies of wood-pulp and wood-meal could

- be made available from the forests of spruce and silver fir in the mountains and fibrous grass from the forests at the foot of the Himalayas. (*Ibid*).
55. Vast quantities of hides and skins are exported which ought to be manufactured into leather. (*Ibid*).

Other Industries

56. In the forests of the South Canara and Malabar Districts and those of the Cochin and Travancore States, enormous quantities of soft and hard woods are felled annually in clearing areas for rubber plantations and temporary cultivations and their timber burnt and destroyed for want of a market for them. I believe it is quite easy to establish match factories in these districts. (*Rao Sahib M. Rama Rao Garu, p. 444*).

Exhibitions

57. Exhibitions have a usefulness all their own, but their utility can be considerably increased by exhibiting in them the improved processes of Western manufacture, alongside of home made articles. (*The Hon'ble Mr. M. B. Dadabhoy, p. xxiii*)
58. Messrs. Parker, Sumner & Co., of Milan, should be invited to set up at a convenient centre a demonstration factory, the Government paying the expenses, and to exhibit the process at the annual exhibitions at the expense of the Exhibition Committees. (*Ibid, p. xxiv*).
59. The example of Japan might be profitably followed for popularising Indian articles in foreign countries. We may fairly claim this sort of help from British Consuls. Arrangements can also be made with foreign mercantile agencies, more easily by Government than by the people, for pushing the sale of

Indian manufactures by the establishment of museums of Indian art work. (*Ibid*, p. xxxviii).

60. Government should, through the British Consuls stationed in the various countries, get detailed reports of newly-invented manufacturing processes, and adopt them in their own factories which will prove distributing centres of light and instruction. (*Ibid*, p. xlii).

Railways

61. Railway freight is another matter in which Government interference in the interest of Indian industry will be a very material help. Government should have a predominant voice in railway administration. A fair readjustment of rates and a more sympathetic reclassification of goods should not present unusual difficulty. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxiv).

Waterways

62. Means should be devised by Government and local bodies for the protection and improvement, by dredging and the construction of anicuts and training walls, of the channels. Easy navigation with an efficient river flotilla will meet the requirements, and provide facilities of communication encouraging to the industries. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxv).

Weights and measures

63. Standardisation of weights and measures is a necessary improvement that demands consideration at the hands of Government. (*The Hon'ble Mr. M. B. Dadabhoy*, p. xxxv).

Resolutions passed at the Seventh Indian Industrial Conference, held at Calcutta on the 29th December, 1911.

Resolution I.

Homage to Their Imperial Majesties.

The Indian Industrial Conference assembled in its seventh Session humbly and respectfully tenders its most dutiful and loyal homage to their Imperial Majesties King Emperor George V and Queen Empress Mary on the occasion of their visit to India to graciously announce in person the solemnities of their coronation to their faithful and loving subjects in this country. The Conference begs to express its grateful rejoicings at the benign assurances of sympathy and regard given in the Royal Proclamation and the boons bestowed upon the people to promote their happiness and prosperity and secure their contentment and attachment.

Moved from the Chair.

Resolution II.

The late Honorable Mr. V. Krishna Swamy Iyer.

This Conference expresses its profound sorrow at the sad and untimely death of the Honorable Mr. V. Krishna-swamy Iyer, C. S. I., member of the Executive Council of His Excellency the Governor of Madras, in whom it has lost one of its most zealous and active supporters, the country one of her best and noblest sons and the British Empire a most loyal and devoted citizen. The Conference authorizes the General Secretary to convey its sincere and heartfelt condolence to the son and relations of the deceased gentleman.

Moved from the Chair in solemn silence.

Resolution III.—Technical Education.

While expressing its appreciation and thankfulness to the Government for the liberal action taken and contemplated, in regard to Technical Education, this Conference once more records its firm conviction that for placing the cause of industrial progress on a firm basis, it is most necessary that the

Government should establish in the country at least one fully equipped Polytechnic College for imparting the highest kind of instruction in the applied sciences and industrial arts and further urges that the visit of Their Imperial Majesties the King-Emperor and the Queen-Empress should be commemorated by the foundation of such an institution bearing their names.

Proposed by—MR. A. CHOWDHARI, (Bengal.)

Seconded by—MR. S. K. NAIR, (Madras.)

Supported by—MR. L. V. KAIKINI, (Berar.)

Resolution IV.—Failure of Industrial Enterprises.

This Conference notes with regret and concern the failure of several industrial enterprises started for carrying on new industries and the effect these failures have produced in damping the ardour of the people in the development of the resources of the country. The Conference calls upon the leaders of the people in the different Provinces and Districts to institute inquiries into the causes of these failures and authorises the General Secretary to depute one or more persons for securing this investigation.

Proposed by—THE HON'BLE MR. R. P. KARANDI-
KAR, (Bombay).

Seconded by—Rao Bahadur V. R. PANDIT, (C.P.)

Supported by—MR. K. S. NARAIN RAO, (Madras.)

Resolution V.—Railway Rates.

This Conference calls the attention of the Government to the prevailing complaints about the anomalous character of the existing Railway rates on goods and their unfairly heavy incidence on interprovincial trade and urges the necessity of laying down for interprovincial consignments the same scales of rates as those for consignments to and from important ports.

Proposed by—MR. N. A. DRAVID, (Berar.)

Seconded by—MR. L. V. KAIKINI, (Berar.)

Resolution VI.—Purchase of Government Stores.

This Conference urges upon the leaders of the different Provinces the necessity of vigilance to secure the effectual and complete carrying out of the orders of the Government

issued in 1909 for the purchase of Government Stores in this country as far as practicable, and appoints a committee consisting of the following gentlemen to watch the operation of the rules and to report thereon to the next Conference :—

Sir R. N. Mookerjee.

Mr. D. E. Wacha.

Honourable Sir Vithaldas D. Thackersey.

Honourable Mr. Lalubhai Samaldas.

Dewan Bahadur P. Rajaratnam Mudaliyar.

Lala Harkishen Lal.

The Honourable Rao Bahadur R. N. Mudholkar.

Proposed by—THE HONOURABLE RAO BAHADUR R. N. MUDHOLKAR, (Berar.)

Seconded by—PROF. R. K. MOOKERJEE, (Bengal.)

Resolution VII.—Director of Industries.

This Conference once more urges that there should be in every Province of British India, a department of industry under a Director of industries to deal with industrial questions and to be in charge of Technical and Commercial education as well as industrial instruction; and that there should be an advisory board of qualified persons not less than one-half of whom should be non-official Indians, who should be consulted on all matters of importance; that the functions of this department should include (1) the supply of advice in regard to new industries, (2) the introduction of new or improved methods and processes, (3) the carrying out of investigation and experiments, (4) the development of selected industries, (5) the organisation of industrial and commercial exhibitions, (6) that there should be an Industrial Museum and a bureau of information under the department of Industry for supply of information to the public on Industrial and Commercial matters.

Proposed by—MR. C. Y. CHINTAMANI, (U. P.)

Seconded by—MR. KALOORAM GANGRADE, (U. P.)

Resolution VIII.—Co-operative Banks.

This Conference welcomes the establishment in the Bombay Presidency of a Central Co-operative Bank and

urges upon the Government and the people the desirability of establishing similar Banks in the other Provinces to help Co-operative Credit Societies and to advance loans directly to agriculturists at reasonable rates of interest.

Proposed by—THE HON'BLE SIR GANGADHAR RAO CHITNAVIS, (C. P.)

Seconded by—RAO BAHADUR G. SHRINIVAS RAO, (Madras.)

Resolution IX.—Indentured labour.

This Conference is of opinion that in the highest interests of the country, the system of Indian indentured labour is undesirable and should be abolished and urges the Government of India to take early steps to prohibit the recruitment of Indian labour under contract of indenture, whether for service at home or abroad.

Proposed by—HONOURABLE MR. N. SUBBA RAO, (Madras.)

Seconded by—MR. POLAK, (South Africa.)

Supported by—MR. PAUL PETER PILLAI, (Madras.)

Resolution X.—Duty on Alcohol.

In view of promoting and facilitating the work of Scientific and Technical instruction in India this Conference urges upon Government the desirability of exempting in conformity with the practice of other civilized countries from payment of duty all alcohol purchased by public educational institutions in this country for strictly educational purposes.

Proposed by—MR. MANINDRA NATH BANERJEE, (Bengal.)

Seconded by—DR. A. CHATTOPADHYAYA, (Bengal.)

Resolution XI.—Appointment of Committee.

This Conference appoints a Committee of the following gentlemen to submit opinions on and offer suggestions in regard to the Co-operative Credit Societies' Bill, the Life Assurance Companies' Bill and the Provident Societies' Bill, now pending in the Imperial Legislative Council :—

The Honourable Mr. G. K. Gokhale.

▼

The Honourable Sir Vithaldas D. Thackersey.

The Honourable Mr. M. B. Dadabhoy.

The Honourable Sir G. M. Chitnavis.

The Honourable Rao Bahadur R. N. Mudholkar.

Babu Surendra Nath Thakur.

Proposed by—MR. J. CHOWDHARI, (Bengal.)

Seconded by—PANDIT GOKARAN NATH MISRA,
(U. P.)

Supported by—MR. A. C. UKIL (Bengal.)

Resolution XII.—Previous Resolutions .

This Conference confirms the resolutions passed in previous Conferences :—

(1) calling upon the Government and the people (a) to encourage and help Indian manufacturers and (b) to foster and encourage the use of such manufactures ;

(2) inviting the attention of capitalists in India to the urgent need of developing and fully utilising the mineral resources of the country and asking them to make organised efforts in that direction ;

(3) urging the special claims to consideration of the Textile and Sugar Industries ; and praying for the repeal of the excise duty on Cotton goods ;

(4) urging the desirability of the standardisation and unification of weights and measures so as to remove the serious inconveniences caused to trade by their multiplicity ;

(5) urging the Indian Universities to create faculties of Commerce, to institute degrees in Commerce and to affiliate Commercial Colleges which will prepare candidates for such degrees, and recommending the establishment of a college of Commerce in each Provincial Capital, which should also provide for the training of teachers for Commercial Schools in the mofussil.

Proposed by—MR. R. C. BONNERJEE, (Bengal).

Seconded by—MR. V. V. JOGIAH PANTULU, (Madras)

Supported by—MR. S. K. NAIR, (Madras).

Resolution XIII.—Office Bearers.

The Hon'ble Rao Bahadur R.N. Mudholkar be appointed General Secretary of the Industrial Conference for the next year, Mr. N. A. Dravid, Honorary Assistant Secretary and Mr. M. B. Sant, Assistant Secretary and this Conference appeals to the public for a sum of Rs. 5,000 to carry on the work of the Industrial Conference.

This Conference deems it desirable that there should be a Standing Committee of this Conference appointed for each year to co-operate with the General Secretary in carrying on the work of the Conference during the year and to advise on all such matters as the General Secretary may submit to them and that the following gentlemen do constitute the Standing Committee for the year 1912 :—

Dr. Satish Chandra Banerjee,
 Mr. Hasan Imam,
 Rai Purnandu Narayan Sinha,
 Sir R. N. Mukerji,
 Mr. J. Chaudhari,
 Sir Vithaldas D. Thakersey,
 Mr. D. E. Wacha,
 Hon'ble Mr. Lalubhai Samaldas,
 Diwan Bahadur P. Rajaratnam Mudaliyar,
 Lala Harkishen Lal,
 Mr. C. Y. Chintamani,
 The Hon'ble Mr. M. B. Dadabhoj,
 Hon'ble Rao Bahadur R. N. Mudholkar, General Secretary (Ex-officio).

Proposed by—THE HON'BLE PANDIT MADAN
 M. MALAVIYA, (U. P.)

Seconded by—RAO BHDR. R. G. MUNDLE, (Berar.)

M. B. DADABHOY,
President,

Seventh Indian Industrial Conference.

R. N. MUDHOLKAR,
General Secretary,

Indian Industrial Conference.

PROCEEDINGS
OF THE
Seventh Indian Industrial Conference.

The Seventh Session of the Indian Industrial Conference was held in the Congress Pandal, Green Park at Calcutta on Friday, the 29th of December 1911, under the Presidentship of the Honorable Mr. M. B. Dadabhoy, C. I. E., Barrister-at-Law, Nagpur. There was a fairly large and influential assemblage consisting of leading representatives from the various provinces of India. The Session was as successful as that of Allahabad held last year. The following gentlemen were noticed among those present :—H. H. Shree Ram Bhunj Deo, Maharajah of Mourbhunj, Sir Rajendranath Mookerjee, C.I.E., Hon'ble Sir Gangadhar M. Chitnavis, Mr. A. Chowdhuri, Mr. J. Chowdhury, Mr. P. Bruhl, Principal, C.E. College, Sibpur, Rao Bahadur G. Shrinivas Rao, Babu Ambica Charan Muzumdar, Mr. Polak, Mr. Sydney Webb, The Hon'ble Mr. S. Sinha, The Hon'ble Mr. N. Subba Row Pantulu, The Honorable Mr. G. K. Gokhale, The Hon'ble Pandit Madan Mohun Malaviya, The Honorable Mr. Bhupendra Nath Basu, Mr. Yatindra Nath Chowdhury, Mr. B. Chakerburty, Rao Sahib M. Ram Rao, Mr. C. Y. Chintamani, Rao Bahadur V. R. Pandit, Mr. R. C. Bannerjee, The Honorable Mr. R. P. Karandikar, The Honorable Dewan Bahadur L. A. Govindaraghava Aiyer and others.

The proceedings were formally opened by H. H. Shree Ram Bhunj Deo, the Maharaja of Mourbhunj, who as Chairman of the Reception Committee of the Conference, delivered the following address in welcoming the delegates.

Maharaja of Mourbhunj.

Before the proceedings commenced the Maharaja of Mourbhunj, Chairman of the Reception Committee, in welcoming the delegates said that it was his most agreeable

pleasant task to accord a hearty welcome to the delegates and visitors, who had assembled there from various parts of India. Their presence here emphasised the growing interest of the country in industrial enterprises and the importance which they attached to the Conference. Without the least fear of contradiction he might affirm that the Conference had served a most useful purpose by bringing together leaders of thought and the pioneers of industry into a fold where they could exchange views and give each other the benefit of their experience in a friendly spirit. The special feature of this Conference was that all sections, classes and communities of the Indian public meet there on a common platform, actuated by one common purpose in an atmosphere of peace where the voice of dissension and strife could never be heard. This should be so, for the industrial problem was the problem of problems. In an age of scientific advancement, of keen competition, in which the struggle for existence was becoming harder day by day, the question of industrial advancement must precede all other questions. Upon it depended the livelihood of the great majority of the people and the wealth and prosperity of this country. They had had during recent years an industrial awakening heralding increased industrial activities in all directions. There was no doubt that the matter was occupying the serious attention of the Government as well as of all thoughtful people in this country. India had its industries in the past and excelled in very many of them, it had its trade and commerce, both inland and sea-borne, it had its great cities and great highways. The circumstances prevailing then had now completely changed. It could no longer had an isolated and self-sufficient life. India was now a member of the international community and must take its share in the strife of commercial competition.

The standards and methods of the west must be adopted and assimilated. That is what he interpreted to be the meaning of their industrial problem. In the west the subject of industry along with economics had developed into a science and general laws had been deduced which were of universal

application, but it did not necessarily mean that all industrial organisations must follow the same lines. The geographical position of a country, its physical features and natural resources, its population and climate, the physical and intellectual developments of its people and the stage of civilization attained by them must be considered first.

Election of the President.

Sir Rajendra Nath Mookerjee in proposing that the Hon. Mr. Dadabhoy be elected as President of the Conference said that Mr. Dadabhoy although a member of the Imperial Legislative Council did not devote all his time for the purpose of making law. He had devoted a quarter portion of his time to the development of Indian industry. He was himself connected with a spinning and weaving mill as well as mining industry and in thus conducting his business he had acquired much practical knowledge of these industries in detail and had thus become a practical man who could give them advice on industrial questions. The Government had recognised his valuable services both in the Council as well as in the development of Indian indigenous industries by appointing him a Companion of the most eminent Order of the Indian Empire this year and that he had the good fortune of receiving that honor at the hands of His Imperial Majesty. The speaker was therefore sure that the election of Mr. Dadabhoy would be carried by acclamation.

The motion on being seconded by the Hon. Babu Bhupendra Nath Basu, was carried unanimously.

The Honourable Mr. M. B. Dadabhoy, C. I. E., Barrister-at-Law, Nagpur, took the chair amid loud cheers and delivered the following address:—

Presidential address.

The following is the text of the address delivered by the Honorable Mr. M. B. Dadabhoy, C. I. E., Bar-at-Law, Nagpur:—

Gentlemen,—I thank you most sincerely for this high honour, specially for the very kind reception you have given

to my election. To preside at the Industrial Conference is a privilege I value, and if I have any title to it, it must be through my past humble work in the line. Industries have always had a fascination for me, and I have through life taken a keen interest in the industrial development of the country.

Need for Industrial Development.

Gentlemen,—I place the industrial regeneration of India above all other Indian problems in importance ; it opens up auroral visions of a happy and prosperous future,—of the revival of the Glorious Ind of the past. Political power, according to the teachings of history, is handmaid to industrial success ; and value as I do the political advancement of my countrymen, I cannot but feel that the greatest block to it is their present industrial prostration. A country notorious for lack of initiative and enterprise, dependent upon foreign supply for the everyday requirements of life, with sources of living narrow, circumscribed and restricted ;— it would be a wonder if the people were not held in political subordination. Political servitude follows commercial and industrial servitude as sure as night the day. It is almost a Natural law, rigorous, unrelenting and unsparing in its operation. Revival of the Indian industries, therefore, offers the most productive and promising field for the labours of the patriot and the statesman. We must go to the root of the evil, and treat the disease at its source ; the pathological conditions must be removed. The pangs of hunger must be satisfied, and all experience shews industry and commerce provide the most effective means.

Government and Popular interests identical.

In this matter fortunately the interests of the people and the Government ought to be and are identical, the objective is the same. It is as much to the interest of Government to promote industrial activity as for the people to develop it. The highest statecraft, the wisest policy suggests and enjoins

encouragement by all possible means of indigenous industries as the first duty of all well-regulated Governments. Much is made of the present

Indian Unrest.

It would be wrong to ignore it; it will be equally wrong to ascribe the whole to a mere yearning on the part of the people for political power, or to the impulse and the gospel of hope which Japan has imparted to Asia. These are potent factors—active, pregnant, contributory causes. There are other powerful causes at work. The poverty of the people, absence of careers for the million, contraction of the productive sources of wealth, unequal competition, absence of commercial facilities and fiscal autonomy, and above all, the general, albeit unfortunate, belief that the advancement of British Industrial interests forms the animating principle of British Indian Rule ;—these felt, perceived, and realised by the people more and more with the spread of education and increasing knowledge of other countries, swell the volume of discontent, and give point and shade to it. "The rebellions of the belly are the worst," and "the surest way to prevent seditions is to take away the matter of them" which is "want and poverty in the estate." This is an eternal verity the force of which does not suffer by age. Lord Bacon's dictum is as true to-day as when he first enunciated it.

Revival of the industries best antidote.

The industrial revival of India is an object worthy of pursuit by the Government and the people alike. Government, if it is to be beneficial and permanent and to fulfil its high mission of advancing human progress, must encourage it; the people, if they are to live comfortably and to take a place among civilised nations, must compass it by every legitimate means in their power. The conditions of modern life are inconsistent with the primitive ways of living of the past; we must be abreast of the times. All progressive nations are becoming manufac-

turers ; in India alone the movement has been the other way. Indian manufactures, once the glories of the East, have practically disappeared, and those that are not extinct lack vitality. Vitality in industry is inseparably associated with progress,—progress in design and process; absence of this progress is demonstrative of loss of vitality, stagnation and decline. There is no stationary point of perfection in manufacture ; the scope of improvement is practically unlimited. Besides, tastes vary and are everchanging, and vigour in industry is indicated by its capacity of adapting itself to the market. Very few Indian manufactures shew signs of this vigorous vitality. The great aim of the Industrial Conference ought to be and is the infusion of new life into such industries, as are not dead, the resuscitation of such as are dead but are useful under present conditions, and introduction of new industries. Success in the work will remove poverty and will provide career for the million. The healthy atmosphere of industrialism is destructive of sedition ; art, industry and commerce are incompatible with turbulence ; they cannot co-exist with disorder, and grow best in peace ; a vigorous Industrial India will have no room for the anarchist, and will contain germs of social and political progress that are bound to fructify under the beneficent influence of England.

Hopeful Conditions.

Gentlemen,—This Conference has a special significance, meeting as it does on the bank of the sacred Bhagirathi,—hallowed with associations of resuscitation, spiritual benefit and advancement, full also of the hubbub and bustle of a go-ahead material civilisation suggestive of the West,—its waters crowded with shipping stuffed with valuable merchandise,—its banks studded for miles with mills and factories, warehouses and entrepots, standing majestically against a horizon sable with industrial exhalations,—in a City the home of the *Swadesi*, the nursery of philosophy and thought,—and synchronising with the historic Visit of the most sympathetic and progressive of Sovereigns which has stirred to its inmost

depths the great heart of the nation and has provided a powerful stimulus to its hopes and aspirations, its activity and enterprise. There is reason for hope in the conditions under which we meet. Industrialism is the talk of the hour. Signs of an increased interest in indigenous industries are visible in the country. There is a genuine desire today among the people to take to industry and commerce in preference to service. Conservatism is wearing down ; improved methods of manufacture are adopted ; Indian goods find increased sale at home ; and what is more important, hopeful and helpful than any, the artistic taste of the nation has been restored.

National reversion to Indian Art.

In 1901 a shrewd observer complained.—

“ Ever since the dawn of history, India has been known as the nursery of art. The painful fact must be admitted, that whatever the cause may be, since our rule has been established, the old art of India has been almost killed ; the taste of the people, formerly led into safe paths by the traditions of Indian handicraftsmen, has been changed and corrupted. We corrupt the artistic sentiment of the people, and by so doing cause the ruin of the ancient handicrafts.”

Things have changed with mighty strides since then ; a wholesome change has come over the spirit of the people's dreams. Corruption of the national taste, however, is not the only cause of the ruin of the glorious Indian handicrafts. Mr. Wilson observed, the British manufacturer “ employed the arm of political injustice to keep down and ultimately strangle a competitor with whom he could not have contended on equal terms.”

But an examination of the industrial and commercial policy of the early British Government is fruitless work except for suggestions for undoing the past, and revivifying the industries. Such inquiry causes a bitterness which does good to nobody. It is enough for our present purposes that the

present day Government is sincerely anxious to advance the material and industrial interests of the nation. Simultaneously with this change in the spirit of the administration the people have developed an active sympathy and fondness for the ancient hereditary art of India. This swinging back of the pendulum carries in it a hope for the future.

Requisites of Industrial Development.

Enterprise premised, four conditions are absolutely necessary for industrial success,—sufficiency of fluid capital, skill, labour and market. Deficiency in any one of these is destructive of industrial success. Enterprise alone can do nothing. The best mental equipment and the greatest skill with plenty of labour are likewise unavailing without capital and demand. Success in industry is dependent upon the combination and co-existence of all these. Now, in India some of these are absent, or are inadequate.

1. Capital.

In the first place, capital is the great need of Indian industries.

Hoarded wealth—exaggerated.

It is the fashion with a class of public men to assume the existence in India of a large hoarded wealth. It is estimated that so much as £550,000,000 is lying idle in the hands of the people. Knowing as I do the country, I cannot subscribe to this theory. As a matter of fact, the lot of the poor is one of hard existence. They cannot save anything. It may very well be that the small savings of the poorer middle classes are secreted for safety, but the total amount cannot be large. The recurrence of famines and the famine mortality prove this. It is significant that the poorer middle classes are the greatest sufferers from famines. The increasing village debt also is destructive of this theory of hoarded wealth. A mass of official literature deals with this indebtedness and the rapacity of the *sowcar*. Were it not for this alarming indebted-

ness Government would not have been so anxious for the development of Co-operative Credit Societies, and for the enactment of relief and restrictive land legislation. These facts and others of a more or less convincing nature point to the conclusion that there is little hoarded wealth in the country to count upon for any effective scheme of industrial regeneration. But supposing for the sake of argument that there is some cash in the hands of the villager, it cannot be set free immediately for remunerative employment. The conditions of Indian society do not foster and encourage a spirit of reckless speculation. Prudence will always counsel the maintenance of a small reserve in the village household. It would have been a matter for congratulation if there had been plenty of this reserve in India, and the reserve was a common feature of village life. Even if, therefore, there be any money in rural India, it, at any rate, any appreciable portion of it, cannot and should not be converted into liquid capital for working the industries.

Deficiency of Indian Capital.

The ugly truth confronts us that India is sadly wanting in capital, capital in the hands of the classes that are likely to invest it on industrial and commercial ventures. "The hoarded wealth" apart, there is hardly much money in the hands of the upper middle classes—money that would flow into industrial channels or be otherwise reproductively employed. Critics who have a laugh at the expense of the shy Indian capitalist fail to take note of the serious obstacles to accumulation of capital in India, as also the fact that the possession of large cash mainly creates enterprise and boldness in business. The Japanese had as much timidity 50 years ago as the Indians, but they have now developed an enterprise which is as remarkable for its boldness as for its success. The history of the industrial development of Japan has lessons both for the people and the Government of this country. But to return to the subject of accumulation. Here I can only touch upon the chief obstacles without attempting a detailed examination.

Obstacles to accumulation.

Agriculture, now at least, forms the basis of India's wealth, and that is heavily taxed. To add to the difficulty, there is an element of uncertainty in the land tax which discourages improvement. Except in a comparatively small area, the revenue assessment is liable to periodical revision; and much as this method of taxation is objectionable *a priori*, experience shews its operation is even more so by reason of the shortsightedness and zeal of the Settlement Department. Time was when the malguzar was the never-failing village capitalist and the powerful patron of the village industries. But now with his attenuated income he has to share with the rest of the people the heavy burdens of a costly administration. If he had any vitality left in him still, that is successfully stamped out of him by the operation of an out-of-date and ruinous law of succession. The Indian Law of Succession—Hindu and Mahomedan alike—has the greatest disintegrating and deleterious influence upon Indian society, and consequently upon Indian capital. Whatever its utility in the past in a society organised upon clannish principles, it is now working ruin in numerous homes, and makes any large accumulation of wealth impossible. The family capital, as soon as it reaches the point when it can be increased with the greatest advantage undergoes a process of disintegration which reduces the participators to actual poverty, or at least throws them back to the original position when they have to start accumulation anew. This process goes on seesaw fashion to the detriment of industry and commerce. Nothing is more certain in finance than that reduplication and growth of capital progress successfully and quickly after accumulation has reached a decent point. The joint family system, again, develop though it might some moral qualities in Man, is productive of idleness and want of foresight, thrift and resourcefulness among the mass of the people. The conditions of Indian society thus offer the least encouragement to accumulation of capital. And it is conceivable that they could not

have existed uninterruptedly for years without producing their normal result of small means and tenuity of capital. Thus it is that the total capital in the country is insufficient for any large and comprehensive scheme of industrial regeneration.

Foreign Capital.

For years to come, therefore, we must look to foreign markets for the requisite capital, and for more reasons than one the London Market offers the greatest attraction. London rules the World's finance, so to speak, and India should have under normal conditions special facilities for raising loans there. Government guarantee would secure almost any amount of capital to Industrial India. That the Indian manufacturer and the Indian trader can legitimately claim at the hands of Government and which, if it is to exist *for* the people, it cannot justly refuse. It is not that Government does not raise loans in England; on the contrary, it does that at times on a pretty liberal scale for the financing of its railway and irrigation projects, and for making up the deficit in the Indian Budget. But the wrong thing about the present system is that it does not benefit the people of the country, except indirectly and in so far as the railways and the irrigation works throw open to them a few petty appointments and facilitate transport and encourage production.

Wanted as loan.

What India wants today for industrial expansion and progress is abundance of foreign capital, not wholly to be employed by foreign manufacturers, miners and merchants for their own profit and the enrichment of their own countries, but as *loan* for application to the various industries by Indians themselves. The Government of India alone can secure to the country foreign capital on these conditions; but constituted as it is and limited as its powers are, it is perhaps an idle hope that it will immediately work out the idea to its logical consequences.

India's right to buy up foreign concerns.

But the suggestion made by my Hon'ble friend Sir Vithaldas Thackersey from this platform that a percentage of shares in companies floated by foreign capitalists should be reserved for Indians, is certainly not extravagant. This modicum of justice the people demand from Government. I would go further : In my humble opinion the people should have the option and the right of buying up the existing industrial concerns owned and managed by European capitalists on terms and conditions that might be settled by Government. It is practically impossible for the Indian, with his slender resources and lack of expert knowledge, to compete successfully with the foreign capitalist with his unlimited resources and his superior and up-to-date knowledge of science and trade conditions. The competition is fatally unequal, and Government will do real and lasting good to the country by equalising it.

Indian Capital.—Reproductive employment.

But while foreign capital must be imported in abundance for financing the industries, there is no earthly reason why the bulk of the capital that there is in the country should not be immediately available for the purpose. The petty savings of the middle classes apart, there is undoubtedly some cash in the hands of the Indian aristocracy and the numerous endowed temples. The law of primogeniture governs the families of the nobility, and all report testifies to the existence of fairly large accumulations in their hands. The accumulations in the noted shrines are equally decent. The big zamindar too, especially in the permanently-settled area, is not without a few lacs. It is a matter of infinite regret, nay of shame, that this cash is not available for industrial purposes. The complaint everywhere is want of capital, and many a good and promising concern has collapsed for want of financial support, and numerous other companies, inaugurated under excellent auspices and under the impetus of the *Swadeshi* movement,

working well at the inception, are now from the same cause in a more or less languid condition, miserably lacking vitality. It is discreditable to the nation that the requisite capital for working even small concerns should not be found. It is all very well for us to lecture Government upon its duties in industrial matters, but we must do our part. To claim Government assistance and not to do what we can to help ourselves, is sure to launch us into a position ineffably ridiculous and contemptible, besides creating suspicions about our earnestness of purpose and even our *bona fides*. Educated Indians have so far supported the small concerns, but by themselves they cannot find much capital. The territorial magnates and the bankers, the only capitalists in the country, must cooperate. The object should be to attract some of their capital into the business. But it seems they are, as a class, not amenable to ordinary influence ; they are not moved by large or novel ideas ; they require other spurs than nationalism and patriotism to move them to action. Government help is especially valuable in dealing with them. As often as not, a significant nod from Government will go a great way. The Khan of Khelat's action in investing his hoard in 8% Government Stocks when Sir James Westland floated the loan experimentally in 1898, points to an unmistakable moral. A judicious distribution of honours among persons engaged in commerce and industry will also have a wholesome effect. Active suasion by local officers should be even more fruitful of result. But Government guarantee within reasonable limits to Indian concerns and periodical audit of accounts should provide the most effective cure for the proverbial shyness and immobility of Indian capital. Loans can also be advanced by Government to promising concerns with advantage. The relief suggested by Messrs. A. Chatterji and J. N. Gupta in respect of provincial concerns should be systematised, and should form a part of the industrial policy of the Government of India, instead of being the result of the individual efforts of sympathetic officers.

Indian Banks.

Then Indian banks, owned and worked by Indians, are a necessity for industrial success. We must have a network of them. Fortunately, there are fewer difficulties in this line. The Indian capitalist is by instinct and training a banker; banking is to him an accustomed art. He has only to be persuaded to operate in conjunction with others through Joint Stock Companies instead of individually. Large banks with limited liability command public confidence, and are sure to attract the savings of the people as deposits. This is the age of Joint Stock banking. Development of the system must be highly beneficial to India. There has been a healthy activity in this direction of late. Far greater activity is needed.

2. Skill—Expert Knowledge.

Equally important with sufficiency of capital is the diffusion of expert and up to date industrial knowledge among the people. Unfortunately some misconception exists on this point. There is a tendency among some people to regard all technical knowledge except that of handling machinery as useless, causing the unprofitable controversy about the relative utility of factory industry and cottage industry which gain in keenness over the cotton industry. Nothing can be wider of the truth than the proposition that expert knowledge is co-extensive with knowledge of machinery and industrial skill consists only of skill in handling modern scientific and mechanical appliances. Manual skill, for productive and remunerative purposes, is as valuable a national asset as the best and most elaborate mechanical knowledge. It is proved by the survival of many ancient handicrafts through revolutions in industrial arts created by the invention and improvement of machinery. The handloom industry is chief among these. Notwithstanding its primitive methods, it has not only existed through centuries, but is today a powerful competitor of powerloom industry, producing, according to the statistics available, almost double the quantity of cloth produced by all the mills of India. If expert knowledge

meant the exclusion of conventional training and education of the Indian artisan, the splendid skill inherited by him from generations of skilful manipulators would be wholly lost to the nation. That is a view neither sensible nor profitable. Indian artwork is still appreciated and valued, only not so much within the country as outside it, though of late there has been a healthy resilience in the national taste. Even in Europe there is a tendency to revert to hand industry, and the improved handloom is gaining in popularity. The scope and object of a well-devised system of technical education should therefore be to utilise and improve the inherited skill of the Indian artisan, to stimulate increased production by the introduction of improved labour-saving appliances, to train the people in mechanics and mill management, and to disseminate such industrial knowledge as would divert the trained activity of the nation into new and profitable industrial channels.

In the course of an industrial survey Mr. A. Chatterji has noticed a regrettable decline in design in most of the industrial products of the United Provinces. But the alarming feature about it is that it is not endemic. It is noticeable throughout India. Generally speaking, the present-day Indian artworker lacks initiative and originality. Schools of design at selected centres, suggested by Mr. Chatterji, should be very helpful. Technical institutes and industrial schools must likewise be started all over the country. Workshop apprenticeship, favoured by Mr. Cumming, will be specially valuable, providing as it will the practical knowledge which India lacks so much. These various agencies will supply to the country considerable technical knowledge. But a comprehensive scheme of technical education must provide for the establishment at suitable centres of Technological Colleges and Research Institutes for the impartation of thorough training in the higher branches of industrial science. Careful training in the complex details of the industrial arts is useful for the mass it is true, but for proper industrial development we must have a class of men well-grounded in the highest

scientific knowledge who will be able to give a healthy direction to the industrial activity of the nation. Well-equipped Technological Colleges and Research Institutes serve a very useful purpose in training up such men. In a vast country like India with its teeming millions one or two colleges can do little. There must be a number of them to work any appreciable good. The Government of India, I thankfully acknowledge, is alive to the importance of the subject, but seems somehow to hesitate to take a bold step forward; it wants to leave the matter to the discretion of the Provincial Governments. This is wrong on principle; it reverses the order in which progress is attained in India. The impulse, the *primum mobile* must come from the Supreme Government, and the function of Local Governments ought to be to adapt the scheme to local needs. Thanks to the efforts of Sir John Hewett, there will be a Technological Institute at the great industrial centre, Cawnpur. As for Research Institutes, with the exception of the one owing its origin to the public spirit and munificence of the late Mr. Tata, there are none in India. Government has a clear duty in the matter. The technical scholarships initiated by Government, for training in Europe and America, doubtless supply a real want. They are very necessary under existing conditions. I wish with all my heart they were multiplied. But we must not blink the fact that the education of a nation must proceed within the country. Thought and knowledge should be imparted, but they must also grow from within.

Demonstration farms, factories and tours.

The institutions suggested above, again, should be largely supplemented by demonstration farms and factories and demonstration lectures by peripatetic instructors. The excellent results attending the efforts of the National Fund and Industrial Association of Madras for the improvement of the local handloom industry by demonstration by touring agents at different centres of the working of improved handlooms, should be suggestive

of similar action for the improvement of the other industries, and the introduction and popularisation of improved methods. Such lectures, to my mind, are more valuable, and provide more effective means of industrial education than even industrial schools. Improved machinery and appliances, if portable, are easily popularised in this way. Leaflets in easy vernacular, setting forth the uses and advantages, the working expenses, the method of working, the productive power, etc., of heavier plant, should be distributed freely among the people. They have a valuable educative influence, and any system of industrial education, to be effective and popular, should provide for them. The cost, even if large, should be incurred in the industrial interest of the people. It will prove reproductive in the long run. Then again what German manufacturers of synthetic dyes have done to popularise them in India by means of their laboratory at Surat, should be possible *mutatis mutandis* for manufacturers of improved machinery to do.

Exhibitions.

Exhibitions have a usefulness all their own, but their utility can be considerably increased by exhibiting in them the improved processes of Western manufacture, alongside of home made articles. Indigenous methods of manufacture of the different provinces have much in common, and do not provide a productive source of inspiration. It is to the West and the Far East that we must look for fresh ideas and fresh impulse. Indian artisans are by general consent an intelligent body, ready to imbibe and adopt new ideas. There is large room for this sort of improvement. The weaving of *Kasi* silk, for instance, is a profitable and growing industry; but what is perhaps a discouraging feature of the business is that the whole of the yarn required is imported into the country from Europe. Italy is the chief manufacturing and exporting centre. Yet we have the materials in fair abundance. The materials used in the manufacture of "schappe" of the yarn are waste silk and damaged cocoons. A

large export trade in them from India exists, the annual amount of waste silk exported alone being about 800 tons. There is no reason why this large material should not be spun into yarn here. Messrs. Parker, Sumner & Co., of Milan, are reported to be willing to help the Indian manufacturer with detailed information and advice. They should be invited to set up at a convenient centre a demonstration factory, the Government paying the expenses, and to exhibit the process at the annual exhibitions at the expense of the Exhibition Committees. In this way more life could be infused into the exhibitions, and their educative value could be enhanced.

Primary Education necessary.

But no system of technical education can be either complete or profitable which seeks to impart only special knowledge to the neglect of general education. We must have Primary Education all over the continent to derive the fullest benefit from Technical Education. Primary Education is as mordant or grounding. It helps the later artistic finish. And in a country like India such education, to be effective, should be free and gradually compulsory.

Public co-operation.

The programme detailed above is perhaps a little ambitious, and it may not be possible for Government to undertake such an elaborate scheme forthwith ; but we ought gradually to work up to it. In this connection our humble and grateful thanks are due to His Imperial Majesty the King-Emperor for the munificent grant of fifty lacs of rupees for the support of education. A large portion of this amount will necessarily be spent on Primary Education, and some on Technical Education. His Royal pleasure and intelligent solicitude for the peace, contentment and welfare of his Indian subjects have placed funds at our disposal which, with judicious distribution, will materially help our cause, and cannot fail to be appreciated. The announcement that the grant will be expansive is an additional hopeful circum-

stance. But in the matter of national education the efforts of Government should be supplemented by those of the public. Here at least there is field for conjoint action and for whole-hearted co-operation between Government and the people. This Industrial Conference too ought to do its part of the work and to contribute its mite. The rich cannot put their wealth to nobler use than by spending it for the support of education. In all advanced countries private charity does a deal for public education. The example can be followed here with profit. I am glad the Indian public have begun to realise their duty, and institutions of the right sort have come into existence. The Victoria Jubilee Institute of Bombay, the Bengal Technical Institute, and the Calcutta Association for the Advancement of Scientific and Technical Education are, each in its own sphere of action, doing excellent work. But the field is large ; the workers few.

3. Labour Supply.

The third requisite of industrial development is supply of labour. India is still supposed to be the land of cheap and plentiful labour. Modern conditions prove the unsoundness of both the theories. Labour is, in point of fact, neither cheap nor sufficient in India. It is getting scarce everyday, and all industries suffer more or less from want of a regular and copious supply. Plague and malaria have made havoc among the labouring population. The supply is diminished. Rural areas have suffered most with the result that agriculture is somewhat neglected and the village industries are in a state of chronic decadence. The difficulty is accentuated by a general movement of the labouring classes to large towns. In urban areas too factory labour supply is anything but satisfactory, being uncertain and the volume varying with the seasons. Wages is apparently low, but judged by its efficiency and productive capacity, Indian labour is really very dear. The Indian labourer has a weak physique, is incapable, from habit as much as from want of stamina, of sustained effort, and is devoid of a sense of duty and responsibility.

He takes but a languid interest in the work, and is indifferent to the interests of his employer. These circumstances invest the labour problem in India with as much seriousness and difficulty as in the most advanced countries of the West. Some of the evils are remediable, arising from poverty and ignorance. I have lively hopes that free and compulsory Primary Education will improve the character of the masses, and will instil in them a healthy sense of duty and ambition.

The supply can be improved by stopping oversea emigration and encouraging inland emigration by substantial inducements. In view of the exclusive temper of the Colonies, the Indian settler abroad is a veritable anomaly. The Indian is not wanted by white colonists except as a cooly. The anti-Indian prejudice appears to be spreading. It is better, therefore, the Indian emigrant should return to the motherland, and help in the upbuilding of its industries. It is far better, far more dignified to sweat at home than to drudge abroad. The people might themselves refuse to go to distant and inhospitable lands. It is within their power.

Then for the encouragement of labour and to facilitate free movement, compulsory legislation like the Assam Labour Law ought to be repealed. It is demoralising to a degree, and checks the free movement of labourers by creating suspicions in their minds about the good faith of the employers. Coercive legislation redounds upon the tone of the market. This is a general proposition which from all experience is applicable to the labour market and the general market alike. Government, I hope, will benefit the general industry of the country by restoring normal conditions to the labour market. The existing arrangement is neither moral nor prudent. It is economically unsound. Monopolies are injurious to industrial development.

The freer introduction of labour-saving appliances for working the various industries, agriculture included, will also materially help the solution of the labour problem.

4. Market—Home and Foreign.

Expansion of the sale of Indian manufactures comes next in order in a scheme of industrial regeneration. The worst feature of the present industrial condition is that the country is becoming too much of a producer of raw materials for foreign mills, and the dumping ground for foreign manufactures, sometimes cheap, inartistic and worthless imitations of Indian art products. In 1813, before the Parliamentary Committee of Enquiry, Sir Thomas Munro ascribed "the excellence of their own manufactures" as one of the potent causes which prevented a large use of European goods by Indians. He himself had used an Indian shawl for seven years, and the long use had not made any difference in it. He further said: "I have never seen a European shawl that I would use, even if it were given to me as a present." Times have changed, and this Brummagem shawl which Munro condemned is now largely in use in this country, to the partial exclusion of the fine Indian shawl. This process of supersession is general and in certain respects complete. The result is, India has come to produce only raw materials, and to send them out of the country to be imported as manufactures. Even the most valuable fertilisers leave her shores. In an industrially and normally developed India this process must be reversed. The raw produce must be converted into manufactures here in India, and the surplus products of Indian factories sold abroad. It is the conditions favourable to the sale of our manufactures that demand examination.

(A). Home Market—Favourable Conditions.

These conditions naturally fall within two groups as affecting the home market and the foreign market.

(a) A Protective Tariff.

Pre-eminent among the former class is a protective tariff. Experience shews that protection is absolutely necessary for the development of the infant industries of a country.

That is the lesson of history. England had prohibitive import duties in the past; Indian imports were kept out by positive prohibition. Mr. Wilson, in his *Continuation of Mill's History of British India*, observed:—

“It is also a melancholy instance of the wrong done to India by the country on which she has become dependent. It was stated in evidence (in 1813) that the cotton and silk goods of India up to the period could be sold for a profit in the British market at a price from 50 to 60 per cent. lower than those fabricated in England. It consequently became necessary to protect the latter by duties of 70 and 80 per cent. on their value, or by *positive prohibition*. Had this not been the case, had not such prohibitory duties and decrees existed, the mills of Paisley and Manchester would have been stopped at their outset, and could scarcely have been again set in motion, even by the power of steam. They were erected by the sacrifice of the Indian manufactures.”

In 1828 Henry St George Tucker, Director of the East India Company, referred to the protective tariff England had adopted against her principal and powerful competitor, India. Sir Guildford Molesworth, in his illuminative paper in this Conference, has demonstrated how the industrial expansion of England has been due to protection. According to Mr. Carnegie, the marvellous industrial progress of the United States of America is the result of a policy of strict protection. Germany formerly kept open door for foreign exports. The maker of Modern Germany, Prince Bismark, reversed the commercial policy with results that have powerfully shaken the economic creed of England, and have roused in her a distinctly protective feeling “to save for herself at least the English market.” Bismark pleaded:—

“Let us close our doors awhile, and secure for German workers the German markets which hitherto the foreigners have exploited with convenience. The abstract doctrines of science influence me not at all; I form my verdict on the teachings of experience. I see that the Protectionist countries

are prospering, and that the countries which practise Free Trade are decaying. Even mighty England is gradually returning to Protection, and will in a few years' time revert to it altogether, in order to save for herself at least the English market. Since we lowered our tariffs, we have, in my opinion, been a prey to consumption. We have been bleeding to death."

Industrial Germany proves the wisdom of Bismark's policy. His prophecy about England promises to prove true. There is a strong body of opinion in England in favour of protection. That India stands in urgent need of protection in the present undeveloped state of her industries, has impressed high authorities. More than a quarter of a century ago Sir Lepel Griffin pleaded for protection to India. Sir Guildford Molesworth put the case for India in a nutshell.

"India requires protection from England as well as from foreign countries."

Other distinguished Anglo-Indian administrators, with their knowledge of the country, have from time to time advocated protection for it. But perhaps the clear and strong opinions lately expressed on the subject by Lord Minto and Sir Edward Baker, speaking with full consciousness of the responsibilities of their position, stand unique for freshness and interest. His interviewer, Mr. Carpenter, the American journalist, said last year, Lord Minto favoured a protective tariff for India, and Sir Edward Baker was reported to have said :—

"I would give them (Indians) a protective tariff. I would encourage the establishment of factories and favour them in every way as to the making of goods in India in competition with those of Europe, Japan and other parts of the world. What India needs is industrial development, and a protective tariff would bring that about. As it is, we are tied up by the manufacturing industries of Great Britain. We can levy no duties to speak of upon our own imports of cottons. We once had a tariff of

5 per cent., but the Manchester millmen objected, saying that it ruined their trade. They demanded that an excise duty be added to equalise our competition, and the result was that the duty was reduced to $3\frac{1}{2}$ per cent., that amount being levied on all goods in India. Do you wonder that the natives object to this? A protective tariff would foster our industries and we could in time build up a mighty industrial empire."

And Sir Edward Baker is one of the highest authorities on Indian finance. After retirement Lord Minto gave candid and strong expression to his views at the Central Asian Dinner in May last.—

"He also urged the necessity for protection of industries upon the development of which the future of India very largely depended. He cited the case of Canada which had become strong by the artificial aid given to industries... Without something like tariff reform he failed to see how great industries could be created. He felt so strongly upon this question because he had the welfare of India at heart."

The London *Times*, commenting on the speech, observed that Lord Minto had made a pronouncement on the protection of Indian industries of the first importance, and few who were in touch with recent developments in Indian opinion would question the justice of his view. It is superfluous to expatiate on the merits and necessity of a protective tariff after this weighty opinion. It is equally needless to multiply authorities. But to shew the trend of non-official Anglo-Indian opinion on the subject, I quote an observation of the well-known financial expert Mr. Reginald Murray. In his instructive paper on the "Organisation of capital in India," after referring to the supposed "hoarded wealth," he said :—

"But neither this nor British Capital will flow to a market in which its operations are checked, and its struggling industries swamped by unlimited foreign competition."

The want of a protective tariff is thus keenly felt by everybody interested in the industrial development of the

country. A protective tariff is almost a *sine qua non* of industrial progress, especially in India, and the Government of India, I feel sure, would adopt it if it had a free hand.

In this connection we all must deplore India's present fiscal dependence upon England. The British Government from its constitution has to depend upon the Parliamentary support of the powerful British manufacturer ; and he will be a bold minister who will do anything to intercept his large profits. India, in the result, is governed in his interest, which is clearly opposed to that of Industrial India. It is devoutly to be wished that India will have ultimately fiscal autonomy and a protective tariff.

(b) "Honest Swadesi."

But so long as this blessed consummation does not take place, it is, in my opinion, proper and legitimate for the people to practise *Swadesi*. The right of civilised citizenship carries with it the freedom of purchase and use of commodities ; and if Indians in their patriotic zeal for the revival and development of the indigenous industries prefer home-made articles to foreign imports, there is no rational cause for complaint. That is quite within the "honest *swadesi*" which Lord Minto as Viceroy commended. As an economic principle this preference of home-made articles is sound. *Swadesi* has nothing to do with politics. The feeling has been in existence for years. There is no casual connection between the two. It has unhappily come to have a political complexion from an adventitious circumstance which is foreign to its nature, scope and purpose ; and now that Royal grace has so thoughtfully removed the cause of bitterness by reuniting the two Bengals under a Governor-in-Council, I earnestly hope this estimable industrial method will not be made to subserve political ends. In my estimation the present feeling of the people is invaluable for its utility in a scheme of industrial development. But it should be divested of all aggressiveness, racial antipathy and spitefulness. It is well for the people to understand that the recent outburst of anarchism has

done incalculable harm to Indian industrial interests. In some manufactures it is impossible to make headway without the support of some such feeling as *Swadesi*. Certain articles of Indian manufacture have to be sold abroad from a regrettable absence of local demand. Not that those articles are not wanted for consumption or that they are in any way inferior to imported articles. We get our supply from abroad while some of the most advanced countries happen to be our principal buyers. This phenomenon has been noticed by Mr. Cumming in his Report :—

“In the manufacture of pig-iron surely there is something wrong when the Indian requirements are met by orders from England, while the Bengal Iron and Steel Company have to seek a market outside of India in Australia. In 1906-07, 1,996 tons were sent abroad from Bengal principally to Australia.”

Since the Government of India is anxious to stimulate production in India, it should encourage the people as much as practicable to use home-made goods in preference to foreign imports. The people should be supported in their attempt to provide the protection which, from its dependence upon a pronounced Free Trade country, Government cannot sanction immediately. As Prince Bismark said, “Let us close our doors awhile.” If the ports cannot be closed, let the markets be closed by inoffensive, lawful and constitutional methods.

(c) Government demand.

Government can also do much to help the development of the Indian industries by extending its patronage to them. The Government of India is a large purchaser, but it prefers to make its purchases in Europe.

The monetary result of the loss of Government patronage is perhaps the least evil involved in this policy. The demoralisation of the people is the greatest evil, because, in their zeal to imitate the Government, as Mr. Havell points out,

“The rich and educated Indians for the most part waste

their substance on the by-products of Western commercialism which they fondly imagine to be Western art."

Government example is infectious; from its position Government rules the fashion; the official style has a powerful influence upon the public taste. The genuine and active sympathy of the Mahomedan Emperor checked the denationalisation of the popular taste inevitable under foreign administration, and gave a healthy impetus to Indian art and industry.

For Government it is an unprofitable policy besides being too expensive. There is considerable force in Mr. Havell's observation:—

"To be out of touch with a people's art is to be out of touch with the people."

For the people, for its demoralising effect, it is even more injurious. There is little hope of industrial regeneration unless the artistic taste of the nation is improved, an active sympathy with pure Indian art is developed in it. The revival of the Indian art will bring in its train the revival of the Indian industries. The present industrial development of Japan is simply marvellous. The Japanese are also "the most artistic nation of the present day." The phenomenon affords food for reflection. It is refreshing to note that there has been of late a healthy change in the Government policy. The Stores Committee marks a notable departure. Their labours raise hopes in the Indian breast which Government should satisfy.

(b) Removal of artificial restrictions to manufacture.

Government can usefully exert its fostering influence upon Indian industrialism in several other directions. Some of the requisites are wholly dependent upon its initiation, while some others stand in need of sponsorial attention. Government alone can remove restrictions to manufacture and commerce. The grievance of sugar manufacturers, for instance, is that they have not got proper facilities for the manufacture of industrial alcohol. This is a valuable by-product which enhances the value of sugar manufacture. Liberal concessions in this direc-

tion will certainly improve the prospects of Indian sugar. Salt is another industry which would receive considerable impetus from a more sympathetic treatment. Some salt is got as a by-product from the manufacture of nitre. The industry was fairly vigorous, I understand, in Behar and other parts of the country only a short time ago, and supported a large body of *numias*. It has declined of late, and in certain places the factories have closed down. A scrutiny into the history will reveal the fact that the lethal influence of a shortsighted Excise Department has not been entirely absent. The excise duty upon Indian cottons has likewise an injurious influence upon the Indian cotton industry. It is felt as more or less restrictive, especially in the present crisis when the profits of the Indian millowners have been cut fine. Forty-four lacs of rupees paid throughout India in 1910-11 prove a heavy burden. It is meet Government should repeal the duty at an early date. Instances could be multiplied to shew that the removal of artificial restrictions will encourage development.

(e) Cheap transport.

Railway freight is another matter in which Government interference in the interest of Indian industry will be a very material help. Mr. Chatterji has dealt with the subject in detail in his excellent general report, and has suggested reduction with reference to particular industries. I can only observe that a general reduction in rates is an exigent necessity. The present competition with foreign imports is unequal, inasmuch as they can be shipped to the Indian ports over thousands of miles of seas at a lesser cost than that incurred by the inland trader in transporting indigenous goods over a few hundred miles of railway. This equalisation of trade conditions is a prime necessity, and we hope the matter will engage the earnest and immediate attention of Government. Government should have a predominant voice in railway administration. A fair readjustment of rates and a more sympathetic reclassification of goods should not present unusual difficulty.

Waterways.

The question of inland transport can be satisfactorily settled, along with a reasonable reduction in railway freight, by the greater utilisation of the numerous waterways of the country. The magnificent rivers, the artificial canals have served as highways from the earliest times ; railway expansion has interfered with this cheap means of transport. The craft tonnage has shrunk, and people have come to be more and more dependent upon railways for the conveyance of even bulky goods. Natural causes have worked even more harmfully in this line than railway extension and the public patronage of railways. Many streams have become choked, especially at the confluence ; bars both at the mouth and in the main body have blocked navigation. Means can be and should be devised by Government and local bodies for the protection and improvement, by dredging and the construction of anicuts and training walls, of the channels. Easy navigation with an efficient river flotilla will meet the requirements, and provide facilities of communication encouraging to the industries to a degree.

Quickness in transit is another direction in which there is large scope for improvement. Transport, even on the railways, is at present very dilatory.

(f) Standardisation of weights and measures.

The enormous diversity in weights and measures in the different localities that now exists is another depressing factor in the Indian economic situation. Their standardisation is a necessary improvement that demands consideration at the hands of Government.

(g) Commercial and Industrial Bureaus.

Commercial and industrial bureaus must have a definite place in a well-devised system of industrial development. Government can guide with expert advice the industrial activity

of the people such as no private company, however well-managed and well-informed, can do. As often as not the timidity of the Indian capitalist is the consequence of failures of inconsiderate and ill-advised ventures. The country needs guidance and advice more than active help in management. Properly organised bureaus can give us this advice. The bulletins and the reports at present issued are no doubt useful, but they lack comparative analysis, and do not give much commercial intelligence. Besides, they do not appeal to a large circle of inquirers, being published in English.

(h) Market Pushing.

Market pushing is another essential factor of industrial success which, so far as the inland market is concerned, is quite within the province of commercial bureaus. But the main part of the work must be done by the manufacturers themselves. This is a new line of activity in India, and people are naturally slow to apply themselves to it with vigour. In times past manufactures used to be advertised by middlemen, the more respectable and prosperous *paikars*, but the profits went largely into their pockets, and the artisans themselves had to be satisfied with just such remuneration as would keep them on to the industries. This system continues to the present day. As an organisation for advertisement in distant parts and ascertainment of market needs, its utility is little. The *paikars* themselves are not intelligent and enterprising enough. The local industries thus languish from isolation. They have also become more or less effete from absence of adaptation to popular tastes from ignorance. The time has come when the Western methods of exploitation of the market through travelling agents must be adopted by manufacturers. The middleman is the relic of an antiquated system. But there is one serious difficulty; *viz.*, the insulation of, and the absence of corporate existence among, the petty manufacturers. India is a country of cottage industries; every artisan works in and with the family in utter seclusion from the commercial world.

The *paikar* is just the agent to suit him. But a change in the *modus operandi* is possible.

**(i) Re-organisation of cottage industries
on co-operative principles.**

The cottage workers can combine, and carry on their business on the co-operative principle with a large accession of profits to themselves. Co-operation both for the sale of the manufactured articles and the purchase of materials will give cottage industries a mighty push forward. Co-operative stores worked by the artisans themselves will be the centres of attraction to distant sellers of materials and purchasers of finished goods. They will also improve the manhood of the country. Patriotic as much as official effort should be directed towards this end,—the introduction of the co-operative system among cottage manufacturers.

(j) National Chambers of Commerce.

National Chambers of Commerce are also a necessity; they ought to discharge a very necessary function. Combination for purposes of trade has been suggested by Western experience. Trade and manufacture without Chambers of Commerce are disjointed and selfish, and consequently lack the vigorous vitality of combined action. The conditions of manufacture and sale should be settled by Chambers. Chambers of Commerce, with centralised powers of direction, are far more satisfactory than separate trade unions. Their influence will be found wholesome and effective in restoring normal conditions in such circumstances.

(B) Foreign Market.

(a) Art Museums at British Consulates.

For the exploitation of the foreign market we must depend even more upon Government help. Government has facilities which no private individual has. Through Government the various British embassies can be utilised for the maintenance at convenient centres of Museums of Indian artwork. The

Japanese have adopted that method to push the sale of their art products through their embassy in India. The example might be profitably followed for popularising Indian articles in foreign countries. We may fairly claim this sort of help from British Consuls.

Arrangements can also be made with foreign mercantile agencies, more easily by Government than by the people, for pushing the sale of Indian manufactures.

Prohibitive import duties upon Indian manufactures—Repeal necessary.

But the point which I want to emphasise is that prohibitive duties upon Indian exports imposed in foreign countries must be abolished. While we keep our doors wide open for foreign imports, while our market is exploited by foreign manufacturers, our entrance into some of those countries is barred by almost legislative prohibition. This is an arrangement unfair in the extreme, and would not be tolerated in any other civilised country. For instance, Australia has kept out Indian exports of *endi* silk by heavy import duties which can only be protective in purpose and effect. Mr. Gupta refers to the duties in his Report :—

"I am informed that about two or three years ago *endi* fabric found a market in Australia, and consequently the trade in *endi* was very brisk for two or three years. But recently it appears that heavy import duties have been imposed on the Assam cloth, and therefore its sale in Australia has practically ceased. I have not been able to verify the accuracy of the above statement."

The caution hardly leaves room for doubt. There is no smoke without fire. Besides, the sudden collapse of a promising and vigorous business could only be due to the interposition of some such artificial check. Moreover, the whole thing is quite in the Colonial style. The statement has not so far been officially contradicted. Government has admitted in Council the existence of the import duties. Mr. Cumming

also notices this danger to the Indian manufacturing industry and remarks in his Report :—

“ The prohibitive rates against tanned goods on the Continent and America prevent any export.”

Mr. Chatterji speaks of similar prohibitive imposts in connection with the industry in gold and silver artware :—

“ The sale among European visitors and tourists has also contracted owing, as I was told, to a heavy import duty in the United States and the Continent of Europe.”

I invite the attention of Government to this restriction and appeal to it for early and vigorous interference.

Our Duties.

I have so far dealt with the various requisites of industrial development. It is in every country the result of long and slow evolution. We all must wait, and patiently work on for years, each of us contributing his quota. It will be foolish to expect Government to do everything for us ; it will be equally absurd to conclude that people can do all by themselves. Government and the people have each to do a certain share of the work. The community in no country has got the power which Government has, and each has its legitimate sphere of action in which it can usefully spend its energies. Government, in all countries and in all ages, has evinced a deep concern for and has worked hard for the industrial development of the people. Modern conditions of trade and manufacturing competition have only increased the responsibilities of Government. International influence and international agreement have come more into play. And Government must, in the natural order of things, represent the community in international dealings. Without active Government help, without an elaborate and continuous policy of industrial reform and encouragement, much progress is impossible ; at the same time the people must shake off all lethargy and lotus-eating habit, and rouse themselves once for all for vigorous action. Overgreat reliance upon outside agency is enervating ; it is the cult of the lazy.

Situation hopeful.

In India we do not start with a clean slate. There is abundance of splendid material to turn to economic use; the people are the fortunate possessors of a dexterity and industrial knowledge that have descended to them through generations of skilful manipulators, and that exhorted the admiration of the world only a century ago. The situation is thus eminently hopeful. Our work lies not in evolving something new out of nothing, but in carefully readjusting the conditions, in removing the anæsthetic of neglect, isolation and ignorance, and in communicating the spark of life into effete industries. It is thus much lighter than that of the Western nations that are now in the very forefront of the world's industrialists. They had to begin new; they had not any industries remarkable for the excellence of their manufactures. But they had grit and courage and won the race by one supreme effort. We must proceed to work with like spirit, and unless our efforts are actively thwarted by the jealous West, we are bound to win. Let us apply ourselves to the work "with heart within and God o'erhead", and success will be ours. There may be failures at the beginning, especially in view of the unfair competition with foreign capitalists, but we gain experience at each failure, and ultimately we succeed. That is Nature's Law. A tedious course of waddling and thumping precedes successful flying. Let failure, therefore, instead of sponging our energies, be only a spur to a greater, a more determined spurt.

Unfair competition.

The deadly influence of the unfair competition alluded to above is best illustrated by the collapse of the Tata line of Steamships connecting Bombay with the Far East through the unfair competition of the subsidised British Companies. The rates were temporarily reduced by these Companies to a point which made competition impossible. Mr. Tata's memorials to Lord Cross, then Secretary of State, and Parliament were unheeded. The natural result followed. The

scheme failed. It is this sort of unfair competition which has to be put down. The British Government would make itself infinitely more popular than it is now by a sympathetic consideration of Indian claims in these matters. Sympathy in Government is essential ;—sympathy, not only with the political aspirations of the people, but with the industrial interests as well, is the redeeming feature, especially of alien Governments.

India governed in Indian Interest.— Fiscal Autonomy.

I repeat India must be governed in Indian interest. Amelioration in the condition of the people and their industries should be the first concern of the Government of India, and where the interests of the foreign manufacturers clash with those of the Indian the Government ought to stand out unhesitatingly as the resolute champion of the latter. But, as I have stated above, under existing conditions the Government of India's powers are limited, and any great reform in its industrial policy must begin with the attainment by it of complete fiscal autonomy in matters affecting the country's trade and commerce. Once this is conceded, we might appeal to Government with greater effect for protection, the abolition of restrictive tariff, the grant of bounties to new and struggling industries and for the pioneering of new industries. Both the latter methods have proved eminently useful in industrially-advanced countries. English public opinion is slowly veering round to our side. The *Morning Post* of London in March last remarked:—

“The Imperial Government cannot in the long run refuse to allow the elected representatives of India to determine her fiscal policy. Sooner or later India will adopt protection.”

State pioneering of industries.

Gentlemen,—The bounty-fed sugar of Germany and Austria is a powerful competitor in the world's market, and the Japanese Government has manufacturing departments in which

Japanese talent is employed. In 1887 Principal Dyer counselled the Government of Japan to establish the confidence of the people in new industries by itself taking the field as successful manufacturer. Japan took the hint, and we know the result. Forty or fifty years ago the Japanese were as shy and timid as any son of India. The State in Japan has trained the people in State schools and factories, and has put heart in them by precept and example. Here in India too the success of the method can be seen within the dominion of that enlightened Prince who has before given us sage counsel from this platform.

Why should not these precedents be followed by the Government of India? It is precisely in this way that new industries can be introduced into the country, and the capital of the people employed in their support. The most improved processes can be shewn in that way alone. Manufacturers are exclusive. Much in the line of dissemination of industrial instruction cannot be expected from them. The point is Government can, by setting up factories, demonstrate to the people the working and the utility of improved Western processes. Government factories would specially supply industrial knowledge. Government should also, through the British Consuls stationed in the various countries, get detailed reports of newly-invented manufacturing processes, and adopt them in their own factories which will prove distributing centres of light and instruction.

Factory system applied to cottage industries.

I have spoken above of only factories. This is an age of machines. Application of mechanical power to the industries to the greatest advantage appears to be the supreme object of civilised effort. Expansion of factories and the factory system is perhaps unavoidable. At the same time it is impossible to ignore the evils inseparably associated with modern factories. The *summum bonum* of existence is not accumulation of wealth.

Life has a higher purpose and a nobler ideal to follow. Materialism has its use, but morality and spirituality are certainly more useful, not only for the development and gradual evolution of the inner side of Man, but also for the purely mundane advantage accruing to society therefrom. The far-sighted administrator would not develop materialism at the sacrifice of morality. A happy blending of the two is the goal of civilised administration. In our zeal therefore for industrial expansion in India we must not import the Western system wholesale, without any modification of details, and without any regard for the needs of particular industries. In building up our industries, we should avoid as much as possible a system which converts man into a slave of machine, and deadens all his individuality and all the finer senses inherent in human nature. There are some industries which in the present stage of human development must perhaps be worked in large and centralised mills, but certainly there are many others which can be reorganised on the factory system, without taking the artisans off their homes, and preserving and utilising their inherited skill. Weaving is one of these industries which can be reorganised that way with the maximum of advantage to the country. The indigenous weaving industry is essentially a cottage industry, and it should remain so for years and years. The effort of the Government and the patriot should be to devise means for increasing its productive capacity without destruction of its present character, or impairing the fine qualities of the hand weaver. That it is possible to evolve a system that would meet the requirements of the case, is now admitted by many. The discovery of electricity has overcome the disadvantages of distance, and the supply of electric power to a number of cottage looms of improved pattern is not beyond the limits of possibility or of human ingenuity. The great point is cheap supply of the power. Herein lies the future solution of the weaving problem.

The controversy about the comparative merits of the

power-loom and the handloom is unnecessarily keen, and it will mean a great saving in energy if the advocates combine for the discovery of means for cheap generation of electricity for distribution throughout India.

Agriculture.

There is one other important industry to which reference must be made here. Agriculture now forms the principal industry of the country. It will always have its legitimate place in any comprehensive scheme of industrial development. We must continue to produce the raw materials as now, the only difference in a normal state of development being that they must not leave the country in an unmanufactured condition. The great needs of the industry are irrigation, introduction of new commercial crops, like rhea and soy bean, intensive cultivation, careful propagation and selection of seeds, detection and treatment of diseases, and improvement both in number and quality of the stock of cattle. Government, it must gratefully be acknowledged, through its Agricultural Department and the Veterinary Department and by providing substantial allotments for irrigation, is making a genuine effort for improvement. Much remains to be done, but the present enlightened policy would be more effective if the people responded to the official stimulus more readily, and applied themselves to the industry with a more intelligent appreciation of the improved methods. Government will, I hope, now move boldly for the preservation of cattle. The present indiscriminate slaughter should be stopped. A more liberal provision of pasture is also required.

Social reform necessary for industrial development.

Gentlemen,—I cannot conclude without emphasising on one other condition of industrial development which appears to me to be of paramount importance. It is unusual to speak of social reform in this connection, but, in my humble opinion, in a country like India it is even more necessary and important

for industrial regeneration than for other results. The exaltation of the industrial castes is of the first necessity. The caste system has often been justified on economic grounds. I am quite prepared to admit that the pursuit of industries by particular castes through ages, is industrially beneficial. But it could never be the intention of the organisers of Hindu society that the castes who do so much good to the community and without whom healthy communal existence would be impossible should occupy only a degraded position, or should be so exclusive as to make future admission of recruits impossible. So long as the industrial castes remain depressed and exclusive there cannot be any large or healthy activity in the line. Exclusiveness produces crystallisation of methods which is opposed to progress. Vigorous corporate growth is impossible in a society disintegrated by mutual des- pise and hatred. Combination and adhesion and unity by affinity is Nature's Law of Growth ; disjunction and dissolution is preliminary to destruction. Contempt cannot be the basis of union. It is love which binds. Once for all we must reconstruct Indian society on the bedrock of love, mutual attachment, mutual help and utility. Let all dissension cease ; hushed be the voice of opprobrium and ridicule. Let all the castes combine, and caste be only the conventional cognomen of the particular industry, instead of being a mark of social superiority or inferiority of its votaries. Modern India should learn and value the Dignity of Labour, the one great idea which lies at the root of American greatness. We must rebuild society in full and warm recognition of the new gospel.

We must also develop among the people a spirit of self-reliance and adventure. The joint family system has sapped the manhood of India. "By the sweat of thy brow thou must win thy bread." That ought to be the creed of the Indian people if they want to come out successful in the hard struggle of life. Early marriage, along with numerous other evils, generates, to give it a good name, a prudence and a calculating habit which is in-

compatible with business enterprise. "Wives and children are hostages to Fortune." A member of society encumbered with family has all enterprise stamped out of him. To better fit Modern India for industrial work the Hindu family system must be considerably modified, and marriage should be less indiscriminate and premature. Intercastal and interprovincial marriages are also important and necessary, as leading by degrees to that fusion of the various elements of Indian society which must be the wish and the objective of every true patriot. United, homogeneous India will not only be a political power, but will also grow into a great Industrial India, which will retrieve the lost reputation of Indian art and industry, and usher into the stage of the world a real living, Glorious Ind. We, sons of India, are we so obtuse as not to perceive these simple truths, and are we so wanting in patriotism and public spirit, are we so dead to our own interests as not to be able to adapt the organisation of our society to modern needs? We are all sons of the same Mother; let us live like brothers, animated by the same feelings, aspirations and ideas, and work shoulder to shoulder for the common weal and the glorification of our dear Motherland.

The Resolutions.

The Presidential address was followed by the discussion on Resolutions. As no satisfactory arrangements were made by the local Reception Committee of the Calcutta Industrial Conference, to engage the services of competent shorthand writers to report the proceedings as well as the speeches on the various Resolutions passed at the Session, full and authentic reports of only a few speeches could be secured and they are given *in extenso*.

The First Resolution.—Homage to Their Imperial Majesties.

The following Resolution was put from the chair and carried unanimously :—

* The Indian Industrial Conference assembled in its seventh Session humbly and respectfully tenders its most dutiful and loyal homage to Their

Imperial Majesties, King-Emperor George V and Queen-Empress Mary on the occasion of their visit to India to graciously announce in person the solemnities of their coronation to their faithful and loving subjects in this country. The Conference begs to express its grateful rejoicings at the benign assurances of sympathy and regard given in the Royal Proclamation and the boons bestowed upon the people to promote their happiness and prosperity and secure their contentment and attachment.'

**The Second Resolution.—The late Hon'ble
Mr. V. Krishnaswamy Iyer.**

The President then moved the following Resolution :—

'The Conference expresses its profound sorrow at the sad and untimely death of the Honourable Mr. V. Krishnaswamy Iyer, C. S. I., Member of the Executive Council of His Excellency the Governor of Madras, in whom it has lost one of its most zealous and active supporters, the country one of her best and noblest sons and the British Empire a most loyal and devoted citizen. The Conference authorizes the General Secretary to convey its sincere and heartfelt condolence to the son and relations of the deceased gentleman.'

The President highly eulogised the late Mr. Iyer as a great political leader and a pioneer of Industrial movement in India whose untimely and sad death was a great loss to the country.

The Resolution was carried in solemn silence every one standing.

The Third Resolution.—Technical Education.

Mr. A. Chaudhuri moved the following Resolution :—

'While expressing its appreciation and thankfulness to the Government for the liberal action taken and contemplated, in regard to Technical Education, this Conference once more records its firm conviction that for placing the cause of industrial progress on a firm basis, it is most necessary that the Government should establish in the country at least one fully equipped Polytechnic College for imparting the highest kind of instruction in the applied sciences and industrial arts and further urges that the visit of Their Imperial Majesties, the King-Emperor and the Queen-Empress should be commemorated by the foundation of such an institution bearing their names.'

In proposing this Resolution, Mr. Chaudhuri said that they had in Bengal some experience about Technical Education. They had done something to establish a Techni-

cal Institute in Calcutta, but their labours had not proved very satisfactory. Large sums amounting very nearly to one lakh of Rupees every year—had been spent on that institution but it was yet difficult to find students. It was their earnest desire that Government who were beginning to do something in this direction should come forward and help them.

Mr. S. K. Nair seconded and Mr. L. V. Kaikini supported the Resolution. Mr. L. V. Kaikini spoke as follows:—

“Mr. President and Gentlemen,

The proposition which I am asked to support derives its unique importance from two facts ; firstly, because it urges upon the attention of Government the most fitting method of commemorating the supreme event of their Imperial Majesties' visit, an event which has stirred the imagination of our people and set free the eternal springs of loyalty and love for their sovereign, the spontaneous exuberance of which has never been surpassed ; and secondly, because if, we, as a nation, are lacking in any one respect more than in any other, if the absence of knowledge in any one department of national activity retards our progress more than in any other, it is the lack of knowledge in the applied sciences and the absence of advanced industrial and technical education. Our progress on the present lines is bound to be lop-sided. Indeed, it is a constant reproach levelled at our educated countrymen, by the practical Westerners, as also by those of our men who have their hereditary commercial instinct to stand by them, that they make good clerks without breaking their backbone, good lawyers without rushing from intellectual subtlety into insanity and good orators without their tongues getting paralysed. The stuff of which pioneers and experts in industrial pursuits are made, is, we are told, entirely different. To some extent, gentlemen, this charge is well-founded and I, for one, would not hesitate to plead guilty but for the fact that it is more the lack of Training and opportunity rather than inherent inaptitude that is responsible for such a deplorable state of affairs. Even in the fields of industrial enterprise

and commercial daring our men, wherever opportunity has served them howsoever inadequately, have come up to the standard and sometimes exceeded it with remarkable distinction. The cotton-mill industry is an instance in point ; in other branches of industry as well, the Tatas have written their name deep in the industrial history of this land. The frequent successes of our students at the higher technical examinations in Foreign Universities have conclusively rebutted the dangerous generalisation of Indian incapacity, which, if permitted to govern the situation would for ever deny us the necessary training and opportunities for industrial advancement. Our people themselves, with the poor resources at their disposal, have made a modest start. This is an earnest indication of what they regard as the supreme need of young India at the present day. The Ranade Industrial and Economic Institute brought into existence by the patient endeavours of the Honorable Mr. Gokhale, the Bengal Chemical and Pharmaceutical Works of which Dr. P.C. Roy the renowned Chemist of Bengal is the guiding spirit and soul, the Calcutta Association for the advancement of scientific and technical education, are all excellent efforts and constitute a very hopeful sign of the future of our country. It is for Government now to help and guide Industrial India in her march by placing suitable facilities for learning the most up-to-date methods of advance, at her disposal.

Gentlemen, there are other difficulties. The want of provision for higher technical education at home compels our students to acquire it in England and other foreign countries. A serious hardship like this has confined such education to the very few to the exclusion of young men imbued with industrial ambition but too poor to incur such enormous expenditure. It must be remembered, besides, that sons of rich men in India, as a rule, have been in the habit of preferring learned professions to the industrial arts, though there are notable exceptions. The necessity of proceeding to foreign countries for the sake of technical instruction, therefore, acts as a serious impediment in the path of those who have the

right desire but not the means to fulfil it. Again, we often hear complaints about the difficulty experienced by Indian students in obtaining access to English manufacturing concerns for the purpose of acquiring practical knowledge. The racial prejudice bars the way. Under these circumstances, it becomes quite obvious that the Government should not delay the establishment of a well-equipped polytechnic college where the necessary instruction would be efficiently imparted.

It may be that India, till the end of time, must primarily remain an agricultural country; but that should not prevent her from becoming a manufacturing country as well. Such a consummation, however, is not possible, unless provision for instruction is made on an adequate scale. It is high time that an earnest beginning should be made in the direction suggested in the Resolution and let us hope that this request will command the entire and whole-hearted sympathy of the Government.

The Resolution was then unanimously carried.

The Fourth Resolution.—Failure of Industrial Enterprises.

The Hon'ble Mr. R. P. Karandikar said :—

Mr. President and Gentlemen,—I have great pleasure in moving the Resolution which runs as follows :—

'This Conference notes with regret and concern the failure of several industrial enterprises started for carrying on new industries and the effect these failures have produced in damping the ardour of the people in the development of the resources of the country. The Conference calls upon the leaders of the people in the different Provinces and Districts to institute inquiries into the causes of these failures and authorises the General Secretary to depute one or more persons for securing this investigation.'

I am glad I am enabled to speak to this Resolution. I am one of those who feel genuine regret and concern at the failure several industrial enterprises have to face in the beginning stages of their career. In the Presidency of Bombay, at

Dhulia there is a cutlery and in one of the recent Government publications an official remark noticed its decay. I was tempted to put an interpellation to the Government of Bombay as to the causes that led to its present condition. It is my firm ground that no Government can afford to look with unconcern upon industries, however pioneer, which like the cutlery are so needful and useful to the community. Some days ago when I visited the Western Countries, I was very much impressed with the genuine desire on the part of the various administrations to help public aspirations and enterprise, especially in matters of science and development of industries, and the opportunities afforded to every class of people to improve their knowledge in this behalf are indeed admirable. For instance in the City of London there were in 1908 no less than 28 Polytechnics and to suit the convenience of people of various avocations, the hours of tuition were so arranged as to afford the opportunity of learning to all. There were day schools and night schools and evening hours of tuition. While that was so in London in 1908, there was then hardly anything like it in India. The circumstance that India is agricultural can no longer support such an apathy. Now when I put the interpellation the answer was straight enough. It said Government made no enquiries and was not prepared to make any but suggested to me to make the enquiry myself. I for one did not regard the answer satisfactory and justifiably disposing of the large question involved in the interpellation. However I am glad to find, soon after, in this Conference, this subject is taken up in right earnest. The first part of the Resolution truly depicts the situation and the second part proposes to deal with the difficulty.

I have no doubt that the Bombay Government have infused a spirit of self-help and if that be also the attitude of other Governments and administrations, there is the greater demand for such a Resolution. With these words I place the proposal before you.

The Resolution was seconded by Rao Bahadur V. R. Pandit, Bar-at-Law at Nagpur in a neat and elegant speech and supported by Mr. K. S. Narain Rao of Anakapalle who spoke as follows :—

Mr. President and Gentlemen,

If Mr. Karandikar has spoken as the victim of the failure of industrial concerns the causes of which this resolution wants to be enquired into, I speak with the little experience, I have, as the promoter of an industrial concern however humble it may be. The proposed committee of enquiry is absolutely necessary and its report would be a very valuable addition to the industrial literature of the country. Industrial concerns generally fail for one or all of the following reasons. Wrong choice of place, the absence of trained labour and expert supervision, the unsuitability of the particular industry to the country, insufficiency of capital, bad or antiquated machinery and the absence of a business directorate to control its affairs. The proposed committee should conduct its enquiry under the above heads.

With these few words I have great pleasure in supporting the Resolution.

The Resolution was then put to the Conference and carried.

The Fifth Resolution.—Railway Rates.

Mr. N. A. Dravid moved :

' This Conference calls the attention of the Government to the prevailing complaints about the anomalous character of the existing Railway Rates on goods and their unfairly heavy incidence on interprovincial trade and urges the necessity of laying down for interprovincial consignments the same scales of rates as those for consignments to and from important ports.'

He said this was a very highly technical resolution. They had been hearing that the existing rates in Railways had been operating detrimentally to Indian trade. The Conference prayed that the Government should make an enquiry and if any anomaly were found in the rates the matter should be immediately placed before the Railway Board.

In seconding the Resolution Mr. L. V. Kaikini spoke as follows :—

“ Mr. President and Gentlemen,

The one simple and predominant fact that should be borne in mind by all while considering questions regarding railway administration is that the railways are made for the benefit of the people. The people are not bound to serve the individualistic and personal interests of railway magnates. The railways have been constructed for the equal benefit of all classes in the country and not to further the profits of any particular community. Broadly speaking, railways in India are public property since most of the Trunk Lines are now owned by the State. Under these circumstances, any unjust discrimination on the part of railway authorities cannot be regarded as at all excusable. Well, gentlemen, that such improper discrimination is found to exist in many instances on Indian Railways is now fairly well-known and the industrial conference is not a day too soon in urging upon the attention of Government the prevailing complaints about the unjust and anomalous nature of the existing railway rates on goods and their unfairly heavy incidence on interprovincial trade in this country.

What we ask of those responsible for railway management is but fair dealing; we want no gift nor favour. The Indian Railway Act of 1890 provides that rates shall be charged to all traders alike without arbitrary discrimination. We, therefore, feel that we are entitled to question the propriety of arrangements which when viewed in the light of such legal provision and judged by the standard of ordinary public equity appear to be not altogether impartial. For instance, we find that the rate for cotton per maund from Khandwa to Mirzapore via Jubbulpore, a distance of 264 miles is Re. 1-1-7; while the same from Khandwa to Cawnpore a distance of 486 miles is only 14½ annas. I suppose we Indians may be credited with at least sense enough to make out that 486 is a larger number than 264! But if we were to solve this mathematical problem by reliance on the

equitable character of railway rates in India we are led to the astounding discovery that the part is greater than the whole! Gentlemen, you all know who are the proprietors of cotton industries in Cawnpore and in the absence of any other satisfactory reasons people cannot help taking this circumstance of foreign or European proprietorship as largely responsible for such an anomaly—and it is not *their* fault.

We also find that the rate for wheat from Delhi to Karachi is lower than from places in the Punjab nearer Karachi. In instances of this kind, however, the railways may, with apparent reason, urge competition among themselves as the cause of anomalous rates, since Delhi can avail herself of the ports of Calcutta and Bombay as well, by railway. In such cases each railway would be compelled to quote the most favourable rates in order to divert traffic to her own line with the result that the different systems would underbid one another to the manifest advantage of Delhi or other places similarly situated. This is all very plausible, indeed, but for the fact that these railways are state-owned and therefore it becomes the duty of the State to see that they are not permitted to wrangle amongst one another to the detriment of fair and equitable railway administration.

As regards incidence of rate on interprovincial trade I need only refer you to Sir Frederick Lely, who in his book "Suggestions for the better Government of India" candidly attests to the existence on the part of railways of a tendency to quote relatively lower rates for both export and import consignments than for local trade. The anomaly does not end here, because in some cases local consignments are charged a higher rate and made subject to owner's risk than those that are intended for shipment from ports and are not subject to owner's risk. Here, we shall be told that it is necessary in the interests of Indian export and import trade to observe such discrimination. Goods intended for export have to pay charges from the place of origin to the port of shipment and also from the port to the place of consumption while local or interprovincial traffic has to pay much less on the whole; and

it would only be aiding Indian production to stand well in competition with the production of other countries in foreign markets if it be charged a lower rate for part of its journey. Mr. R. D. Metha the eminent Calcutta businessman who has closely studied this whole question says that this argument does not at least apply to wheat and cotton. Besides, any concession in rates to Indian export traffic is plainly dependent on what the export goods of other countries which are India's competitors in similar production have to bear as transit-charges before reaching the foreign market. Here, interprovincial trade is not quite a relevant factor.

Gentlemen, these are our principal grievances ; there are several minor ones, of course; but this is hardly the time to refer to them. The pith of our demand is "give us like treatment under like conditions" for the present. Indeed, I would be prepared to go further and demand special treatment for Indian enterprise and its production as distinguished from the mass of imports that dump the country every year. But that apart, we are entitled to ask for at least "a fair field and no favour." Let railways be fair in granting rates and let them not be guilty of unjust manipulation of rates either in favour of foreign trade or of any industry at any particular place in India itself. The only effective means to remedy such anomalies and prevent them seems to be to empower the Railway Board to interfere in such instances and make the decisions of the Board binding on all railways. It is astounding that the Board has no such power now so long as the railways do not transgress the limits of maxima and minima rates. But, within those limits, the railways are at perfect liberty to play fast and loose with the interests of those with whom, for reasons of their own, they are not much in love. Such a condition of affairs ought not to be permitted to continue. The railways in this country are not private corporations owning no laws, no regulations and no dictates of equity, but they are only agents of the State, entrusted with the administration of State property according to certain rules and certain accepted conceptions of public

interests and rights. We trust, therefore, that Government will carefully look into this question and take the necessary steps to remove legitimate grounds for complaint and grievance.

With these few words, gentlemen, I commend this Resolution to your acceptance.

The Sixth Resolution.—Purchase of Government Stores.

VIGILANCE COMMITTEE.

The Hon. Rao Bahadur R. N. Mudholkar moved :

' This Conference urges upon the leaders of the different Provinces the necessity of vigilance to secure the effectual and complete carrying out of the orders of the Government issued in 1909 for the purchase of Government Stores in this country as far as practicable, and appoints a committee consisting of the following gentlemen to watch the operation of the rules and to report thereon to the next Conference :—

Sir R. N. Mookerjee

Mr. D. E. Wacha

Honourable Sir Vithaldas D. Thackersey.

Honourable Mr. Lalubhai Samaldas.

Dewan Bahadur P. Rajaratnam Mudaliyar.

Lala Harkishen Lal.

The Honourable Rao Bahadur R. N. Mudholkar.

He said that all the Government stores were formerly used to be purchased from England. But various representations were made to Government. The result of that agitation was that a Stores Committee was appointed to enquire into the matter. The Committee made certain recommendations and the Secretary of State sanctioned the proposal. Since that time an order was passed to the effect that anything which could be purchased from India would be purchased from India provided that the goods were equal in quality. The object of the Committee would be to see that that order was carried out.

Professor R. K. Mukherjee supported the resolution which was carried.

The Seventh Resolution.—The Director of Industries.

Mr. C. Y. Chintamani moved :—

'This Conference once more urges that there should be in every Province of British India, a department of industry under a Director of Industries to deal with industrial questions and to be in charge of Technical and Commercial education as well as industrial instruction; and that there should be an advisory board of qualified persons not less than one-half of whom should be non-official Indians, who should be consulted on all matters of importance; that the functions of this department should include (1) the supply of advice in regard to new industries, (2) the introduction of new or improved methods and processes, (3) the carrying out of investigation and experiments, (4) the development of selected industries, (5) the organisation of industrial and commercial exhibitions, and (6) that there should be an Industrial Museum and a bureau of information under the department of Industry for supply of information to the public on Industrial and Commercial matters.'

Mr. Kalooram Gangrade seconded the resolution which was carried.

The Eighth Resolution.—Co-operative Banks.

Sir. G. R. Chitnavis moved :—

'This Conference welcomes the establishment in the Bombay Presidency of a Central Co-operative Bank and urges upon the Government and the people the desirability of establishing similar Banks in the other Provinces to help Co-operative Credit Societies and to advance loans directly to agriculturists at reasonable rates of interest.'

He said that Co-operative Banks were very helpful to agriculturists and artizans and they were bound to save them from usurous money-lenders. The speaker had some experience of these societies in his part of the country and he had no hesitation in commending them for the rest of India.

Rao Bahadur G. Shrinivas Rao seconded the resolution which was carried.

The Ninth Resolution.—Indentured Labour.

The Hon'ble Mr. N. Subba Rao Pantulu moved the following Resolution :—

'This Conference is of opinion that in the highest interests of the country, the system of Indian indentured labour is undesirable and should be abolished and urges the Government of India to take early

steps to prohibit the recruitment of Indian labour under contract of indenture, whether for service at home or abroad.'

He said that this resolution was bound up with their self respect and honor and he urged that for the honor of their country, indentured labour ought to be abolished not only in South Africa but also in other countries.

Mr. H. S. L. Polak (S. Africa) said that he seconded the resolution with the greater pleasure, in that he hoped that the good fortune that had befallen S. Africa in the stoppage of indentured recruitment for that part of the Empire would be conferred upon all those places to which indentured labourers from India went every year. Whilst it was true that the indenture question had a political aspect, which had been dealt with at the Indian National Congress, it nevertheless had also a very great economic importance. An analysis of the savings of the labourers who returned showed that the material advantage to India of their emigration was almost intangible, whilst the number of immigrants scarcely at all relieved pressure of population, admitting, for purposes of argument, that this existed. But the greatest economic objection to the system, in his opinion, was that a labour force was permitted to leave India, to enrich in different planters in other parts of the world, which force could, he understood from industrial experts, be easily absorbed in useful production in India itself. But this labour would have to be intelligently and sympathetically organised, if it were desired that it should be availed of. Otherwise the continuance of the system would be a burden upon the economic conscience of India. He trusted that the Conference would not rest until indentured recruitment was completely stopped.

Mr. Paul Peter Pillai supported the Resolution, which was then carried unanimously.

The Tenth Resolution.—Duty on Alcohol.

Mr. Manindra Nath Banerjee moved the following resolution :—

'In view of promoting and facilitating the work of Scientific and

Technical instruction in India this Conference urges upon Government the desirability of exempting in conformity with the practice of other civilized countries from payment of duty all alcohol purchased by public educational institutions in this country for strictly educational purposes.'

Mr. M. N. Bannerjee observed that as alcohol was absolutely necessary for scientific and technical purposes, the duty on it should be abolished and cited the example of European countries, where this liquid was free of duty and therefore comparatively cheap.

The resolution was seconded by Dr. G. Chattopadhyaya, who said that his association with the resolution, urging that alcohol should be duty free, did not show that he was a drinker and pointed out the necessity of the abolition of this duty.

The Eleventh Resolution.—Appointment of Committee.

Mr. J. Choudhuri moved :—

'This Conference appoints a Committee of the following gentlemen to submit opinions on and offer suggestions in regard to the Co-operative Credit Societies' Bill, the Life Assurance Companies' Bill and the Provident Societies' Bill, now pending in the Imperial Legislative Council:—

The Honourable Mr. G. K. Gokhale,
 The Honourable Sir Vithaldas D. Thackersey.
 The Honourable Mr. M. B. Dadabhoy,
 Sir G. M. Chitnavis.
 Babu Surendra Nath Thakur.
 The Honourable Rao Bahadur R. N. Mudholkar.'

The Resolution was seconded by Pandit Gokarna Nath Misra and supported by Mr. A. C. Ukil and after being put to the Conference, it was unanimously carried.

The Twelfth Resolution.—Previous Resolutions.

Mr. R. C. Banerjee moved that :—

'This Conference confirms the resolutions passed in previous Conferences :—

(1) calling upon the Government and the people (a) to encourage and help Indian manufacturers and (b) to foster and encourage the use of such manufactures ;

(2) inviting the attention of capitalists in India to the urgent need of developing and fully utilising the mineral resources of the country and asking them to make organised efforts in that direction ;

(8) urging the special claims to consideration of the Textile and Sugar Industries ; and praying for the repeal of excise duty on Cotton goods ;

(4) urging the desirability of the standardisation and unification of weights and measures so as to remove the serious inconvenience, caused to trade by their multiplicity ; urging the Indian Universities to create faculties of Commerce, to institute degrees in Commerce and to affiliate Commercial Colleges which will prepare candidates for such degrees, and recommending the establishment of a College of Commerce in each Provincial Capital, which should also provide for the training of teachers for Commercial Schools in the mofussil.

Mr. V. V. Jogiah Pantulu seconded the resolution which was carried.

The Thirteenth Resolution.—Office Bearers.

The Hon. Pandit Madan Mohun Malaviya moved :—

The Hon'ble Rao Bahadur R. N. Mudholkar be appointed General Secretary of the Industrial Conference for the next year, Mr. N. A. Dravid, Honorary Assistant Secretary and Mr. M. B. Sant, Assistant Secretary and this Conference appeals to the public for a sum of Rs. 5,000 to carry on the work of the Industrial Conference.

This Conference deems it desirable that there should be a Standing Committee of this Conference appointed for each year to co-operate with the General Secretary in carrying on the work of the Conference during the year and to advise on all such matters as the General Secretary may submit to them and that the following gentlemen do constitute the Standing Committee for the year 1912 :—

Sir R. N. Mukerji,
 Mr. J. Chaudhuri,
 Sir Vithaldas D. Thakersey,
 Mr. D. E. Wacha,
 Hon'ble Mr. Lalubhai Samaldas,
 Diwan Bahadur P. Rajaratnam Mudaliyar,
 Lala Harkishen Lal,
 Dr. Satis Chundra Bannerjee,
 Mr. C. Y. Chintamani,
 The Hon'ble Justice Syed Hasan Imam,
 Rai Purnendu Narain Singh, Bahadur,
 The Hon'ble Mr. M. B. Dadabhoy,

Hon'ble Rao Bahadur R. N. Mudholkar, General Secretary (Ex-officio).

Rao Bahadur R. G. Mundle, seconded the resolution which was carried.

THE ANNUAL REPORT.

After this the President called upon the General Secretary to present the Annual Report to the Conference. The Honorable Rao Bahadur R. N. Mudholkar, the General Secretary of the Conference laid it on the table and made a few remarks pointing out the necessity of more funds for touring on an extensive scale for rousing public interest in the industrial development. He also referred to the need of introducing some practical features in methods of work of the office. The adoption of the report was carried unanimously.

PAPERS.

The Hon. Mr. Mudholkar then read out the names of those gentlemen who contributed papers on Industrial subjects. The Papers were taken as read for want of time. He thanked heartily the writers for their courtesy in placing at the disposal of the Conference, very valuable literature on economical and Industrial matters.

With a hearty vote of thanks to the chair the proceedings terminated.

A STUDY IN PARALLELISMS, OR, ECONOMIC AND
AGRICULTURAL DEVELOPMENT IN
ENGLAND AND INDIA.

BY C. E. LOW, ESQ., I. C. S., J. P., C. I. E., DIRECTOR OF
AGRICULTURE,

C. P. and Berar, Nagpur.

The existing state of the economic and agricultural development of India presents a most interesting series of problems, even to those who are in no way personally or politically concerned with the guiding of the various movements that are going on in connection with it. There is one line of research, at any rate, that is probably more familiar to English than to Indian students of political economy, namely, a comparison of the present state of things in India with the corresponding conditions of village and town life in England, at a time when they were perhaps even less developed than they are in the India of to-day. It is in the hope that the possibilities of such a comparison may interest Indian students of their country's economic development, rather than with any serious intention of attempting to answer the question *Quo vadis*, that presses itself so insistently on all spectators of the industrial and agricultural career of the country during the last few years, that I have attempted to give the following brief and imperfect outlines.

I have a word of warning to add regarding the points to which attention should be directed. There are important differences, as well as important resemblances, and it may seem surprising to say, that the former are the less obvious and often the more important. To take a single

instance, from the earliest years of its history, the rural districts of England have contained a very effective form of self-government; though the names of its officers might differ under different rulers and dynasties, Roman, Saxon or Norman, it has always been there, and has always, except during one or two brief periods of unusual disturbance, been able to secure safety of life and limb and security of property for the small farmer or artisan, as between himself and his fellows. Oppression by the great of the small is no more absent from the history of England than from that of any other nation, but any system of autochthonous administration, outside the village unit, and not derived from the ruler of the country, is what we do not find in India. To turn to another and less important point, I must state that the illustrations of parallels in India to similar phenomena in England are taken entirely from the only part of India with which I am personally acquainted, namely, the Central Provinces.

England in the early middle ages was an agricultural country to an extent even beyond what may be found in the India of to-day. At least five-sixths of the population lived in villages, and a very large proportion of those who lived in such towns as there were, held more or less agricultural land. Thus we find the townspeople of Coventry, one of the most important towns of the period, engaged in fierce disputes with the abbot of an adjoining monastery, regarding their respective rights to the arable and common land attached to the town. What trade there was, was mostly in luxuries required by the rich, and brought from abroad. Purple cloth, silk, spices, wine, gold and gems, and the like, not omitting the important article of common use, salt, were the principal objects of exchange. For other articles the village was self-sufficing. The stage of development in which the villagers are divided

off into different industries, such as weavers, carpenters and the like, had only just been reached. Not many years before, every cultivator spun and wove the wool of his own sheep into a rough kind of garment. The village supplied itself with food from the produce of its own fields, wove its own cloth, lighted its own houses with candles made from the fat of its own animals, and the common people depended on the outside world for nothing except salt and iron, which they purchased from travelling merchants, who visited the large fairs, that were held all over the country at important centres, on religious festivals. This fact alone puts England far behind the India of a hundred or even two hundred years ago, in economic development, when it used to own a skilled caste of weavers, whose products were exported all over the world. The towns contained each its gild or association of traders. Most of them were merchants, there were not many pure artisans at that period. Those who did make goods also sold them, but as a rule only in response to a special order. These persons associated together for the mutual protection of their business. They all contributed to the common purse, the object of which was to pay the baron or lord of the town an annual fee for protecting or rather for not illtreating them ; it was also available to ransom any member of the gild who got into trouble when away from the town on business ; for religious ceremonies, and for assistance to the poorer brethren of the gild. I will now ask you to look at the state of affairs some two or three hundred years later, in the middle of the 14th century. We then find in the villages, separate weavers, carpenters, blacksmiths, and the like. In the towns there are large collections of cutlers, leather workers, and above all weavers ; for the weaving of wool was as important an industry as the weaving of cotton in

India. The English weavers, however, did not learn fine weaving till a much later period.

The corporate life of municipal towns presented several very curious features. In addition to the gild merchant, or (later) the traders or artisans' gilds already described, there was the governing body of the corporation, that probably took its origin from the first named institution. All these bodies had for their chief concern, the encouragement of the trade and industry in the first place of their own gild and in the next of their own town, at the expense of any other person or body of persons whatever. As regards the first point, they took particular care to see that the members of their trade did not make bad wares, and did not work secretly, so as to defeat the attempts of the gild organisation to inspect the character of their work. Artisans and traders were only allowed to work or sell in certain fixed places. We have to go back a long way in Indian history before we find the gild so living and active a force as it was in medieval England. There were numerous ordinances for the keeping up of prices, the prevention of foreigners—a word which included all persons not members of the particular town—from sharing in the profits of retail trade, and the maintenance of a proper standard of quality. The medieval conception of price was something quite different to the modern idea of a figure fixed by supply and demand. The canon law in particular aimed at the idea of a just price, *i. e.*, a price that gave the merchant or artisan a reasonable or living wage, and the burgess or statesman was fully in sympathy with this idea. The canon law was a derivative from the Bible and the writings of the Fathers of the Church, common to the whole of Christendom, and concerning itself with matters which were considered fit for religious rather than for secular ordi-

nance, among which at that time were the taking of interest, the making of wills, and the methods of trade, in their ethical aspect. The canon law was a real force, and embodied public opinion to an extent that may perhaps surprise a modern English reader, accustomed to resent intrusion of the authority of the Church into the affairs of everyday life. But religion entered into such affairs far more than to-day. Usury was not only reprobated by the canon law, but loathed by the people at large. Its practice was confined to the Jews, and to members of nations whom, curiously enough, nearness to Rome had made more careless of its decrees.

To return to the medieval town, there was a strong sense of corporate life that has probably never been paralleled in an Indian town till recent years. Members of the different guilds were in the habit of making large donations of money or land, for the spiritual or temporal welfare of the gild, and at a later date, the leading burgesses loved to beautify their town with handsome buildings, or their rooms of meeting with splendid articles of plate. The establishment of magnificent churches recalls the temple-building proclivities of pious rulers and merchants in India, but mixed up with the pious sentiment that prompted the English devotee, was a strong desire for the glorification of his native town or village.

Practically no English town has ever been established that does not owe its existence to its position as a trading centre. In all cases, they have been founded, not by kings, but by traders. London, the capital since the earliest times, was such simply owing to its excellent facilities as a port. The King lived at London, and made it the seat of his administration, because it was the largest and most convenient centre for his purpose. There is no parallel in English his-

tory to what was a very common event at the foundation of an Indian dynasty, namely, for the King to choose some convenient spot, and say to the people "let there be a city here." Such cities owed their very existence to the presence of the monarch's court, which drew to it and required for its support the concentrated wealth of all the host of small towns and villages throughout the realm. This was collected as land revenue and benefited the capital by being spent there by the king and his officers and favourites. In England, no doubt, many of the nobility lived in the large towns for a part of the year and spent a large proportion of their incomes there. But what made the town, was the natural flow of trade to it, attracted by the advantages of its position; and every nobleman, even the King himself, lived for a great part of the year in his own estates, and consumed the bulk of their produce locally. In the above facts are a number of striking and deep-lying points of difference between the fundamental characteristics of the two nations. An English village of this time consisted of a row of huts, built of stone, rubble, wood, mud, or turf, and thatched with straw or turf, according to the nature of the country; these houses had no windows, and only a hole in the roof for a chimney. Each house had its enclosure, with grass and a few half-wild vegetables and fruit trees and with a byre, in which the cattle of the cultivator were kept at night. Surrounding these were the cultivated fields of the village. These were divided into three or four large divisions, called 'shots' very much like the divisions of the villages in most parts of India; and in the Central Provinces especially Chhattisgarh, where they are called *khars*. Now these were cultivated in what will seem, and no doubt really was, a most inconvenient fashion. Each cultivator held his land, not in one or two large fields,

but in little strips scattered all over the village. A holder of 30 acres, which was as much as one plough could cultivate and was the usual size of a holding, possessed 60 half acre strips, scattered over every part of the village lands. This is just what we find in Chhattisgarh at the present day, but as I shall explain owing to a different reason.

In the Chhattisgarh division of the Central Provinces, the people are suffering under precisely similar inconveniences, but the force of custom and the sense of individual ownership that has grown up under the years of British rule, are too much for the people, and changes are hard to make. A hundred years ago, the cultivator would have felt that he had no right to the particular piece of land he was holding, any more than to any other particular piece of land; what he had a right to was a certain amount of the village lands to cultivate, and so long as he had that, he had no just cause of complaint. This fact was recognised by the periodical redistributions that took place at intervals, and were called *lakhbata*. There is, I believe, no real trace anywhere in India of the joint ploughing that underlies the English village system that I have been describing; whether this was due to the light and easily tilled nature of the Indian soil, which has always been easily ploughed by a single pair of small oxen, I am not aware.

Now the English cultivators held land in this way, not because, at the time of which we are speaking, it was the most convenient, but because it had been at one time necessary, and they were unable to change it. This kind of cultivation arose from the fact that the cultivators in still earlier times, used to club together to plough and sow. One man would find an ox, one the wood for the plough, another having nothing to contribute would work

as ploughman. In the Venedotian code, which was the law in force in early times in South Wales, it is laid down exactly in what way the land shall be divided up among the people who have found the animals and plough equipment. The ploughman took the first furrow as his own and sowed seed in it, the man who found the plough irons the next, the man who found the land side ox the next, and so on ; there were usually eight oxen in a team, and it is rather startling to hear that the man who drove them walked in front with his face towards them, and the plough was fastened to their tails. A length of 220 yards is called in English a furlong, which means a furrowlong. A piece of land one furlong long, and one rod broad is a rood, and four of these roods make an acre. If you look at the map of an old English village, you will see that most of these strips are each just about a furlong in length. Every man has naturally to have a right of way to his separate plot, and you can imagine what an enormous number of paths there must have been, and what a splendid opportunity for disputes lay open to a quarrelsome man.

The crops were sown according to the old three field system, of tilth, etch and fallow. Tilth crops were sown after fallow, and usually consisted of wheat and rye, sown in autumn. The etch crop, etch meaning stubble, was usually but not always sown in the spring, after ploughing up the wheat stubble which was first grazed over by sheep, cattle or poultry. It usually consisted of barley, oats, peas or beans. Wheat was the staple food of the better parts of the country, mixed in places with rye, and in the northern and western tracts, which were more backward, the principal food was oats or rye. Generally the standard of living was higher in England than in other European countries, but the country was specially liable to famine ; '*Anglorum*

fames, or 'the famine of England' was mentioned by a medieval European writer as the curse of the country. The only reason that is ascribed for this, was the fact that the people were accustomed to live well and extravagantly, and alternated between seasons of extreme plenty and cheapness, with times when prices were 9 or 10 times higher than ordinarily.

It is quite clear that it was impossible to improve the breed of cattle with such a system of agriculture. No fodder crops could be grown, as long as fields were all grazed over directly after the harvest. The people moreover did not know of the advantages of such crops till many years later, and were therefore unable to feed their animals in the winter. The animals, wandering all over the village, dropped their manure here and there, so that cultivators had very little benefit from the dung of their own cattle, though there were instances of herding animals in a field at night for manuring. Moreover, owing to all the cattle of the village, good and bad, roaming together, it was impossible to keep a good breed distinct, and infectious disease was readily communicated. Nowadays, in England, every cultivator keeps his own cattle in his own enclosed field. One of the most important things that the Agricultural Department has before it is to improve the cattle, and these same difficulties confront us now in India, especially in Chhattisgarh, with the added one that the Indian cultivators burn their cowdung for fuel, which was not a general practice in England, where there was generally plenty of wood. When in the 16th and 17th centuries enclosures of fields and fodder crops came in, it was possible to stallfeed animals during the winter; they increased in size and number, gave more manure, which in its turn made the field more productive. Oxen were generally used for ploughing in the middle ages,

though horses were more usually employed for pulling carts and carrying packloads, in which most kinds of merchandise were taken about. Gradually the horse displaced the ox, until now there are only a few places in England where plough oxen are to be seen, and even there their use is by no means general.

Now, who were the cultivators of these lands I have been describing? In the first place was the lord of the manor. He might have only one manor, or he might have several hundreds. A writer on household management in the 13th century advises large landowners to have a clear account of what food was to be found in stock at each of their manors, and to arrange to stay at them one after another, so as to eat up all the supplies, without waste. These supplies came from the home-farm of the landlord, and from the tenants. The home farm was cultivated mostly by the serfs and tenants, with a few hired servants of the lord, under the supervision of his reeve or bailiff. There were three classes of servile tenants. The villeins or yardlings, who were by far the most numerous class, held an area which corresponded to what a pair of oxen could cultivate, or about thirty acres. This area was called a yardland. There were also so-called 'half-villeins', who had only one ox, and held about 13 acres. The next class was that of the cottars, who had no cattle, and had only their cottage and its enclosure of about 5 acres, which presumably they cultivated by manual labour or by hiring cattle from some one else. There is a class of cultivators in most Central Provinces districts, who have no cattle, and who pay for the cattle they hire from others by working so many days in return or in some other way. The lot of these men is a hard one, and I do not think that the lot of the medieval cottar was very much better. But it

was better than that of the lowest class of serfs or slaves. Here is what a writer of the eleventh century says of one of them. "Be it never so stark winter I dare not linger at home for awe of my lord. I have a boy driving the oxen with a goad iron, who is hoarse with cold and shouting. Mighty hard work it is, for I am not free." Now the tenants, both cottars and villeins, had to do certain work for the lord or as it is called in most districts in the Central Provinces *begar*. The villeins at ploughing time had to plough for two or three days in the week the manorial land, usually clubbing their cattle together to make up a team. They had to find a certain amount of seed for the lord's land. Then they could also be called on at other times for work for a certain number of days. They had also to make payments in money. Thus, a manor in Huntingdonshire has on record that the villeins had to give 10 bushels of oats at Martinmas as fodder corn, 20 eggs at Easter, 10 eggs on St. Botolph's day, and also to pay something towards making the milldam and digging the vineyard. The daughters of the villeins could not marry, without a fine being paid by their fathers, who had to escort their landlord in his journeys up to a certain distance, and to carry his wool and corn to market, with their own animals. Almost every manor had its cornmill, and all the tenants had to take their corn to be ground at that mill, and nowhere else. The landlord naturally got a good rent for the mill if he leased it out. The tenants also had to go with the landlord when he went hunting, and drive the animals. Sometimes they had to keep his dogs for him. The cottars had to do similar services only as they had no cattle, they had to do more personal work.

In return for this, the tenant got, besides the right to

cultivate his share of the village lands, the right to take wood from the manorial forest, when there was any, and to graze his cattle over the whole village lands, after the crops had been cut. He was not allowed to graze all the cattle he liked—only a fixed number. There were certain meadows that were temporarily enclosed, and cut for hay, but most of the grass land was only grazing land.

Now, it is very improbable that the tenant was contented with such an arrangement, but law and custom were too strong for him, and if he had given up his land, some one else would have been only too glad to get it. Still, a change gradually came on. Some landlords did not much care for the trouble of making the tenants come and cultivate the homefarm, and were glad to let it out on a money rent or to take rent from tenants instead of labour. The existence of tenants on rent in the village side by side with tenants on servile tenure was bound to lead to changes. Still, for long the village was entirely self-sufficing. Many tenants brewed their own beer and baked their own bread. The wool of the sheep was spun and woven by their wives and children. They made harness for horses and cattle from willow twigs. If a man wanted anything of a more elaborate nature, he had to wait for the nearest fair, which gatherings were held at convenient spots at regular intervals and were frequented by merchants from all parts. The close parallelism to an Indian village, especially in the matter of the commutation for *begar*, now provided by the village customs roll, will at once suggest itself.

The village had its village servants, much like an Indian village; there was a carpenter and a blacksmith, a pinder or poundkeeper, a village herdsman who grazed the common herd of the village, and a hayward or hay-keeper who saw that the meadows kept for hay were not

trampled down or grazed over. With the open field system, and relying as they did more on the watching of fields or cattle than on fencing the fields, the functions of the last three persons must have been no sinecure. Village servants were, as in India, paid either by rent-free land, or by contributions of grain or food from the tenants. In England the parish priest held a far more important place than the village Parsai or Joshi does in India. If the Joshi has a mafi holding, it is usually almost the poorest land in the village, but the parish priest had very often a piece of land called glebe, as well as the tithes or tenth part of the agricultural produce of the village, whether animal or vegetable. In return for this, he held the religious services, taught the children of those who could spare them from work, and often kept a bull for the use of the village.

In spite of what sounds like a description of hard times and little comfort, there was much to alleviate the lot of the poorer cultivator. In the first place, the people of that time were a much more deeply religious folk than their descendants of today. Every village had its religious gild, very often several of them. These were much like the town gilds already described. They held solemn processions and religious observances at the great festivals of the church, when the village would give itself up to religious ceremonies and merry-making; and there was always a general feast, followed by games. Then there was the parish church, which was always open, and to which every person in the village repaired for worship at least once a day, or, at the sound of its bell heard far off in the fields while at his labour, he bowed his head and murmured the prayers appropriate to the day and hour. In fact, in matters spiritual, the Englishman of the 14th century, could you but have met him, would have seemed much

more akin to the Hindu than his modern descendant. Religious law, as has been already said, entered very largely into the affairs of everyday life. The poor, under the manorial system described above, were never suffered to want. The lord of the manor, though his people were more like his slaves than his tenants, was yet bound to keep them from actual starvation, so long as they remained in his village. It was not till the changes which I am going to describe made the link between the upper and lower classes one of interest rather than of tradition, that the dreadful problem of pauperism, which is at the present moment the most serious before the English people, began to raise its head. The strong religious compulsion of the Christian law, which prescribed the care of the poor as one of the three great duties, also went far to alleviate their lot. It was fulfilled by constant acts of petty charity, by the endowment of hospitals and monasteries for the reception of the indigent poor, and by the payment of the tithes, of which one-third was supposed to be for the poor, one-third for the maintenance of the church fabric, and one-third for the clergy. How far these pious gifts have been diverted from their original purpose, is a matter of general notoriety.

I have thus sketched for you the conditions that ruled the English village of the 14th century, and we have now to see how it has developed into what we see to-day. What had at one time been a good and useful custom, that of ploughing the land jointly and holding it in scattered strips, had grown into a serious clog to further improvement of agriculture, and no effort of Government or persuasion of its officers could have altered it. That had to be left to the logic of events.

Just so in Chhattisgarh the cultivator of the present day will readily admit that his scattered holding is a great

drawback to good cultivation, but when we try, as Government did a few years ago, to get him to exchange fields with his fellow-tenants, so as to bring his holding into a compact whole, we find that his distrust and conservatism are too strong to overcome, and so we should have found, I doubt nothing, in the case of the English manorial tenant of 600 years ago. How then did the change come about? The main cause was the awful calamity of the Black Death, or as we call it now, plague, that swept over the whole of Europe in 1349. The visitations of plague in India, dreadful as they are, are in no way parallel with that terrible calamity, that reduced the population of England by one-half in the course of fifteen months. The ordinary death-rate, as seen in the record of the appointment of parish priests, was increased about 12 or 15 fold. The living did not suffice to bury the dead. The fields went out of cultivation, the harvests rotted on the ground, and the grass grew in the village streets. With this enormous loss of population, landlords could find no tenants to till their land, and labourers were not to be had, except at wages double or more than double of what they were paid before. The price of corn stayed as low as it was before or nearly so, and gradually farmers found that it no longer paid them to grow so much corn. The landlords had to take the land into their own cultivation to a large extent, and, as they had not the labour to cultivate it, they were also inclined to lay it down as grazing area and keep sheep there. These causes gradually operated, till, after some 300 years had passed, a very large proportion of these scattered strips of cultivated land had been thrown into sheep walks. Many men kept as many as 20,000 sheep. Instead of recognising that the country was adapting itself to the circumstance of a lessened population, Government tried

to restrict the number of sheep that might be kept, but as usual in vain. At a later date, an English writer says, that the sheep, though so gentle and innocent a creature, was really worse than a lion or a tiger, because, instead of only men, it ate up houses and farms as well, meaning that sheep farming had been the cause of the decline in arable farming and rural population.

The most important product of the English farmer for many centuries was wool ; and much attention was paid to this by the Government, as the export tax on wool, which was for many centuries nearly all sent abroad to Holland or to Italy to be woven, was the most important cash revenue of the Crown. It was also the constant policy of King Edward III to do all he could to improve the breed of sheep, and to get the manufacture of cloth taken up in England. The principal weaving centres of England were in the eastern and western counties, where it was practised in large villages and small towns ; and it was not till a later date that the weaving communities of Lancashire and Yorkshire arose. The former, as everyone knows, have taken up cotton weaving, but the latter have still retained the art of wool weaving, though now it is carried on in factories. During the middle ages, England was the most backward of western countries, not only in respect of manufactures but even of trade. It was the result of the policy of her kings, that the wool trade laid the foundations of her present industrial position. The powerful weapon of protection was employed, first to raise the price of the new product, and next to prohibit its export, and thereby build up a trade in cloth. As I have said, at one time the wool of England was all worked up on the looms of Florence and the Netherlands. Foreign weavers were invited into England, at first to the great disgust of the local weavers and cloth merchants, to

weave the finer and more elaborate materials, and the outcome of this was the skilled weaving communities of the eastern, western and northern counties. A not inapt parallel may be found between the wool trade of England, built up on a local staple and by the example of foreign weavers, and the cotton trade of the west of India, which has now passed largely from the hands of its European founders, into those of Indian capitalists. Whether a corresponding line of protective policy would have equally beneficial results under modern conditions, is a question on which I am not prepared to enter. By the reign of Elizabeth, we find the state of affairs in rural England to be as follows. Over most parts of the country farming was carried on in the old open field system, but there were also very large areas held as sheep farms. The style of farming was also improving. We had also learned from the Dutch to grow fodder crops, and the farm animals, instead of starving half the year on frozen grass, were now well fed all the year round. They produced more manure, and that gave better crops. Where the farmer was no longer tied down to farming by scattered strips, he was able to utilise the knowledge of improved methods that had come into the country. But in the midst of this comparative prosperity, there was one fearful blot. The cultivators and labourers who had managed to make a living on the land with the help of common rights that gave them a little grazing for their cattle were in bad case, when the landlords put the cultivated lands into grazing, and enclosed the commons. The landlord felt no further obligation to keep them, since they had challenged his right to make them work at low customary wages, and wandered off to other villages to get as high wages as they could. The roads were therefore full of 'valiant beggars', as the laws of that

time called them, who were a menace to the community. Pauper legislation began to be enacted, which was previously as unknown as it is in India of to-day. Any person found begging was to be whipped and sent on to his parish, which was bound either to find work for him, or to maintain him, and taxation was imposed for that purpose. This was an unpopular measure and the landlords of a parish did their best to avoid it, by pulling down the cottages where the poor people lived, so that there should be as few as possible to become chargeable to the parish rates. The unfortunate labourers had to live where they could, and most of them were unable to find cottages near where they had to work, which meant that they had to rise an hour or two earlier, and walk in the cold and darkness of a rainy winter morning to their work. This and the poor food that their miserable wages provided for them had a bad effect on their health, and when we remember the fact that plague was still a regular visitant every few years, that small pox had now become a very serious cause of mortality and that malaria and fevers caused by insanitary dwellings were rife, it is not to be wondered at that the expectation of life in those days was very much lower than it is now, and that men were then as old at 50 as they are now at 70.

To these miseries of the poor, there was added yet another, the decline in wages. After the Black Death, there was a period during which the labouring classes were more prosperous than they ever were, before or since. There was little or no rise in the price of food, and their wages had doubled. You have only to look at the effect of plague in the Punjab of to-day, and you will see a somewhat similar state of things. Here, however, as in the rest of India, a rise in prices is setting in, and it is proba-

bly due to the same cause as that which shortly after began to operate in medieval England. Owing to the discovery of America, and the enormously increased production of the precious metals, the price of all articles of food and ordinary use began to rise to an unparalleled extent. Seasonal fluctuations there had been, but this rise in the price of food had come to stay. So it seems that to-day the increased output of gold in South Africa has a good deal to do with the rise in prices that has affected the world. There was in England another cause that is happily absent in India, namely, the debasement of the coinage, that was begun by Henry VIII and was continued by his son. In the face of these happenings, it is well to consider what is likely to be the outcome of the present rise of prices. It is fortunate that the rise in wages has in India occurred almost simultaneously with that of prices, but if the latter outruns the former, we may be threatened with the same terrible pauperism as England had to face in the sixteenth century.

Turn we now to the towns. Here we find that industries had become more specialised and centralised. There had arisen a class of merchant adventurers, to whom England owes her overseas Empire of to-day, who traded across seas in their own ships. There were also merchants of woollen cloth, of leather, of iron ware and the like, who purchased their wares from the artisans who made them. This meant that capital was increasing, and that the money earned by trade or manufacture was accumulating, while it was being used to forward still more the very industries that had produced it. Finally, the Government of the towns was no longer in the hands of the various guilds, but of properly empowered and regularly constituted municipalities, who had grown out of

these trade guilds. But even yet the artisan employment available in the towns was not enough to absorb the displaced labour of the country. That was reserved for a still later stage, with a description of which I will bring this paper to a close. The process of the substitution of compact farms of a large size for small scattered holdings went on slowly till about the beginning of the 18th century, when arable farming became so profitable that the sheep grazing began to decline. This was the signal for the final acts of enclosure, that took place between about 1740 and 1830 and completed what the 16th century had begun. Instead of the open treeless fields divided into their narrow strips, with a close packed cluster of huts gathered round the parish church and manor house, you will find in England of to-day a country of large fields, separated by hedges, with farms and cottages scattered all over the whole country, and not confined to the village site. *Pakka* roads lead to every village, indeed, in most cases, to every farm-house or group of cottages. But the great and most important change was in the towns. In quick succession were invented the arts of smelting iron with coal, of spinning and weaving by machinery, of calico printing and of porcelain and ornamented pottery making. The power mill, worked by wind or water, was introduced in the 17th century, while the steam pump, followed by the steam engine, came in during the next century. The result was an enormous demand for unskilled or semi-skilled labour; but, owing to the fact that labour had not yet organized itself for its own protection, and that the prevailing sentiment of the time favoured a policy of allowing employers and labourers to settle the rates and conditions of wages by mutual agreement, this increase of factory employment was accompanied by a great deal of misery, and, though labour

has now won a partial recognition of its rights, the struggle has left a legacy of class hatred which had never been known before in England, and is at the bottom of the active socialistic tendencies of to-day.

I do not know if any deductions may be drawn from these facts, but there are one or two that I would like to suggest. One is, that all nations have to pass through more or less the same processes of evolution, and England of 600 years ago was very like, allowing for differences of climate and national character, the India of to-day. Another is, that there is not much difference in the happiness of a nation at the different periods of its growth. A nation gains in power by progress in economic development, but its individuals are not as a whole the better off or the happier. Though the labourer of the middle ages ran the risk of having his wife or daughter taken away by an oppressive lord, or of being made to work long hours for no pay, or of being thrown into prison without cause, he was in little or no danger of starving, so long as he stuck to his village, and the wages he earned sufficed to purchase him a larger share of the necessaries of life than has been the case with the labouring class in any succeeding century. He also found it far easier to obtain a piece of land and become a member of the farming class. Security of life and legal rights have been purchased at the cost of security of livelihood. Let us apply the parallel to the case of this country. India stands economically at the parting of the ways. That it will ever become exclusively or mainly a manufacturing country, I do not believe, but there is no possible doubt that a large enough portion of its population will at no distant date come to depend on industrial resources. And when this comes to pass, we must not imagine for one moment that the country will have reached a haven of security. It will have exchanged one set of

difficulties for far graver ones. Pauperism in India, which is bound to be the result of a large population entirely divorced from all connection with the land, and drawing their livelihood from the fluctuating demands of trade, will be a vastly more difficult problem even than in England, where we have hardly as yet begun to solve it. But are we therefore to recoil from the path of progress on which our feet have been set, ever since the world was created, and living beings were placed therein? We cannot, even if we would, and no man is worthy of the name of such, that would if he could. But we can draw a sober confidence from the history of others that have trod the path before us, and advance, without fear, with hope of the ultimate future, and with the full trust and belief that the Power that made this world and all that is in it, is fulfilling its own purpose in ourselves, for the benefit of the whole created universe.

COTTON CULTIVATION IN THE CENTRAL PROVINCES AND BERAR STUDIED FROM AN ECONOMIC ASPECT.

BY D. CLOUSTON, ESQ., M. A., B. SC.,

Deputy Director of Agriculture, C. P. & Berar.

1. No crop in the Central Provinces and Berar has received more attention within the last half century than cotton. Within that time the mill consumption of the raw material in Great Britain, America, India and the Continent has increased enormously. There has been considerable variation in the prices from year to year; but they have always remained sufficiently high to make the cultivation of this crop more profitable than that of any other grown in the cotton tract. Bumper crops in India

itself have little effect in lowering prices, as the world's supply of the raw material is never quite equal to the demand. Prices have therefore remained high, and the wealth amassed in the cotton tract of these Provinces has been very considerable. Wealth has brought in its train many desirable features : it has raised the standard of comfort of the whole population of the tract. Their homesteads are commodious and comfortable and their cattle are the best to be found in the Provinces. The people are better educated, too, and more enterprising.

2. The area under cotton, which in 1868-69 was only 2,037,617 acres, had increased to 4,176,561 acres 40 years later (1908-09): while in 1909-10 it had topped $4\frac{1}{2}$ million acres. The great increase in the area has been largely at the expense of wheat and millets. The rapid expansion in the cultivation of this staple has in no small degree been due to the improved railway facilities which have been introduced within the last half century. Previous to that time the Central Provinces and Berar were almost inaccessible. The two great cotton marts outside the Provinces were Bombay and Mirzapur on the Ganges, to which cotton was carried by road by the Banjaras. The load, (*bojha*) of about 240 lbs. consisted of two loose bags slung pannier-fashion on a bullock's back. The cost of transport in this way often exceeded half the value of the cotton. Much loss was suffered in transit, too, for the cotton was eaten by the bullocks, stolen by the drivers and damaged by the dust. The dirty state in which this fibre had been exported had long been a cause of complaint among English mill-owners. Previous to that time little inducement had been offered to the grower to supply clean cotton, as no more was given for clean samples than for dirty ones. The ryot was, it is said, in the habit of sowing his cotton broadcast in certain districts as a mixture with *tur*, *juar*

and other crops : he seldom did any weeding and did not start picking till all the bolls had matured. The village *bania* as middleman adulterated his purchases with cotton seed, earth and water ; there were as yet no European agents stationed in the Provinces to set the standard of honesty in the trade. The exporter, who was directly interested in getting cotton of good quality, was stationed in one of the big marts and never came into direct touch with the producer, who, therefore, remained in ignorance of his requirements as to quality. It is not surprising that under these conditions Indian cotton became a byword among English mill-owners, whose opinion was that it would never be used by them, except as a make-shift in the event of a shortage in the American supply.

3. The first real attempt at improvement of this staple in these Provinces dates from 1866, when Mr. Rivett Carnac was appointed Cotton Commissioner (i) to introduce foreign staples, (ii) to improve the indigenous plant and (iii) to watch over all affairs relating to cotton and to further, so far as might be legitimately possible, all interests connected therewith. At this time the cottons of the Central Provinces and Berar were classified as *Chanda jari*, *bani* or *Hinganghat* and *Berar jari* or *Oomras*. *Chanda jari* and *bani* were different names for the same variety, which was known as *Chanda jari* when grown as a cold weather crop in the district of that name, and as *bani* or *Hinganghat* when sown in other parts of the cotton tract in the beginning of the rains. The staple of this cotton was described 40 years ago as being fine and silky and quite suitable for the English mills—being nearly equal to middling American. It is interesting to note that samples of the selected *bani* now grown on the Akola Farm have this year been valued at 8·40*d.* per lb., when middling American was selling at 8·07*d.*, which proves that this,

our long stapled cotton, has been improving rather than deteriorating in the quality of its staple. Berar *jari* or *Oomras* was slightly inferior to Hinganghat: the name was applied very possibly to all cottons containing a mixture of *bani* and the finer types of *jari*. The Cotton Commissioner decided to concentrate his attention on the improvement of *bani* or Hinganghat mainly, and to improve it by seed selection. Large quantities of Hinganghat seed from the locality of the same name were sent to Berar, Nimar, Jubbulpore and Chhattisgarh, as well as to other Provinces. In 1867, 855 tons of seed of this variety were distributed. The results were disappointing: *bani* did badly in most places and from the selection of seed no results of proved value were obtained. Trials made with American Cottons at this time proved equally unsatisfactory. Though grown with great care they gave poor yields of lint and the fibre was weak. The efforts made to facilitate transport, however, were much more successful. Owing largely to the exertions of the Cotton Commissioner the rolling stock of the country was increased, new branch lines were opened, suitable yards for storing cotton were provided, and baling presses were introduced. Though the highest expectations formed at the period of the American war were hardly fulfilled, the course of the cotton trade was after the first five years—one of steady progress: gins and factories sprang up one after another, and the control of the trade tended steadily towards Indian hands, the pioneer European firms dropping out one after another.

4. The next important attempt at improvements dates from the year 1904, when the Government of India in response to an appeal from the British Cotton Growing Association urged Provincial Governments to take up the question of cotton improvement once more, and suggested the following lines on which it might be carried out.

(i) The botanical examination and classification of all existing varieties of cotton, both wild and cultivated. (ii) The introduction of better varieties and improved methods of cultivation. (iii) The provision and distribution of good seed of the varieties ordinarily grown. Steps were again taken in these Provinces to improve the staple ; but, strange to say, forgetful of the failures of the past an attempt was made once more to push *bani* at the expense of *jari*, which needless to say once more ended in failure. Very few cultivators could be induced to purchase *bani* seed, which the Department had collected for distribution, and those who did were dissatisfied with the poor yields of lint obtained.

5. In 1906 it was decided to work out a scheme of improvement on scientific and economic lines with the sole aim in view of benefiting the grower. The different indigenous races were classified, and plant-to-plant selection was started in the case of each. Exotic varieties were freely tried, and field experiments were started, designed to ascertain the relative values from an economic aspect of these, and of the indigenous cottons.

6. The result of the classification of the cottons grown in all the cotton growing taluks showed that the so called *jari*, the almost universally prevailing type, consisted of a heterogeneous mixture of different races—the plants of which differ greatly in their habit of growth and in the quality and quantity of their lint. In the classification, I was guided by the work previously done by Prof. Gammie whose assistance throughout has been invaluable. The character of the mixture was found to vary greatly in different parts of the Provinces. In the Tapti valley and Nimar the finer types, *viz.*: *malvensis* and *vera* predominate ; in quality the lint of this mixture is probably very similar to that of the *jari* or *Oomras* grown 50 years ago. In the South includ-

ing all Berar, where cotton cultivation is more advanced and the cultivators more intelligent, the coarser but more productive types, *viz.* *rosea* and *rosea cutchica* were found to be in excess : this mixture is commonly known as Berar *jari*, *katevilayti* or *varadi*. Its origin is doubtful : it is said to have been introduced from Khandesh. The classification of 6 typical samples, three from the Central Provinces and three from Berar is given below :—

Locality.	Percentage of—				
	Malven- sis and bani.	Vera.	Rosea.	R. cut- chica.	Upland Ameri- can.
Hoshangabad, C. P. ...	26	61	12	0	1
Nimar, C. P. ...	38	55	0	5	2
Bhopal. ...	57	42	1	0	0
Kelapur, } Berar. }	14	7	37	26	16
Amraoti, } Berar. }	19	22	33	24	2
Ellichpur, } Berar. }	16	16	59	8	1

7. The *jari* types in most cases form at least 90% of the mixture : the remaining 10% being made up of American Upland varieties, locally known as *gogli kapas* and *bani*. These cottons vary greatly in the quality of their staple and in their percentage of lint to seed. The lint of *buri* and *bani* is nearly 1" in length, while that of the *roseas* is but little more than $\frac{1}{4}$ ". *Rosea* gives 39% of lint to seed, while *bani* gives 26% only. As it was found difficult to discriminate between *bani* and *malvensis*, when there was no lint available, they have been classed together. The former, however, forms only a negligible part of the mixture,

except in a narrow strip of country bordering on the Nizam's Dominions and far from the railway. The repeated attempts made to restore its pristine glory have failed, because the ryot knows that it is a poor yielder, that it is difficult to pick, as the bolls are so small and the plant so tall and straggly, and that it is less hardy than *Katevilayti*. The percentage of exotic cotton of the Upland type in the mixture varies from 1 to as high as 15% ; but it generally falls below 2%. A trial of numerous exotic varieties resulted in *buri* being selected as the most promising. It has since been proved to be immune to wilt disease and to be more suitable than *jari* for districts where the rainfall is high.

8. In the past far too much stress has been laid on the importance of quality of staple as opposed to quantity. In the absence of accurate knowledge as to the outturn per acre, ginning percentages and relative values of the lint of the different races grown, the methods of improvement adopted were largely based on the requirements of Lancashire Mills. What was good for the ryot was lost sight of. After having gained a fuller experience we are compelled to admit that, under present conditions, quantity is a more important consideration than quality, and that over nine-tenths of the cotton area *rosea* is a variety which will pay best. Many buyers never look at the length of the staple at all ; those who do, pay more attention to such good qualities in the lint, as "freedom from dirt", "bulk", "colour" and a high ginning percentage, than to length of staple. This is easily understood, when one takes into account the great demand there is for short stapled Indian Cotton in Europe and Japan. To get the full market value for a long stapled cotton in India it must be sent to an agent who has a special purpose for lint of that class. The grower seldom has the business acumen to do this, and therefore loses heavily when he grows a cotton

of superior staple ; but, even if the full market value were paid, it would be exceedingly hard to find any long stapled cotton that would compete with *rosea*, which gives a heavy yield of cotton of a kind which is much in demand. In these Provinces, arrangements have been made by the Department of Agriculture to collect and sell the long stapled cotton grown to the Empress Mills, Nagpur. Though the prices paid by the Manager, Khan Bahadur Bezonji, compare very favourably with the valuations of the same cottons in Manchester, it is evident from the statement below that even after making these rather troublesome commercial arrangements in the interests of the grower, *rosea*, on account of its yield and very high ginning percentage, is easily the most profitable variety for the cultivator to grow.

Variety.	Average yield for 4 years in lbs. per acre.			Value at this year's prices in Nagpur.
	Of Kapas.	Of lint.	Of seed.	
G. Neglectence Malvensis.	373	112	261	Rs. 57 5
Vera.	343	115	228	51 11
Rosea.	402	161	241	69 14
R.Cutchica	412	150	262	66 0
Berar Jari.	371	132	239	58 5
G. Hirsutum (Buri).	303	100	203	57 15
G. Indicum (Bani).	255	74	181	44 3

9. It is certain that large quantities of such long stapled cottons as *bani* and *buri*, which Lancashire requires, could be grown in the Central Provinces and Berar should the prices paid for the lint prove remunerative to the grower.

At present they do not, except under the very special conditions to be noted later. It will be gathered from the statement below that, if we were to deal directly with Lancashire instead of disposing of the lint locally, the price realised for our short stapled cotton relative to that of middling American, would be even higher than the trade pays for it here, and that to substitute a long stapled cotton for it would, under these circumstances, prove still less remunerative for the cultivator. By exporting his cotton to Lancashire he would, under the most favourable conditions, get about 33 % more for a long stapled cotton such as *bani* than for his short stapled *rosea*; but the outturn of lint of the latter would, on the other hand, exceed that of the former by about 117%, so that, if he were to grow and export *bani* at present prices, it would be at a comparatively heavy loss.

Variety.	Valuation of lint per lb in December 1910 by			Middling American.
	Manager, Empress Mills, Nagpur.	Wolstenholme & Holland, Liverpool.	Guddam & Co., Manchester.	
Rosea.	6·49d.	7d.	6·75d.	8·07d.
Malvensis.	7·42d.	8·20d.	7·75d.—8d.	
Bori.	8·67d.	7·90d.—8d.	8d.—8·25d.	
Bani.	8·81d.	8·40d.	8d.—8·25d.	

10. The purchaser pays the same price for the lint of pure *rosea* as for that of the Berar *jari* or *katevilayli* now grown over nearly all the cotton tract; but *rosea* gives a ginning percentage of 39, while in the statement below, kindly supplied by the Manager, Empress Mills, Nagpur, it will be seen that for Berar *jari* the percentage for the past three years has been about 35 only: so that *rosea* will give over 11 % more lint than the mixture at present grown.

GINNING PERCENTAGES OBTAINED AT FACTORIES.

	1908-09.	1909-10.	1910-11.
Yeotmal.	35·17	34·16.	33·85.
Akola.	35·00	35·43.	34·38.
Amraoti.	X.	35·71.	35·40.
Nagpur.	35·07.	35·77.	34·65.
Wardha.	34·33.	35·10.	34·29.

11. *Rosea* is a hardy variety and therefore suffers less than others from the vicissitudes of the climate and the cracking of our black cotton soil ; it is the earliest, too, of all the races grown, and its seed gives the highest germinating percentage. It is capable of great improvement in its ginning percentage by plant-to-plant selection. The selected strain which is now being propagated on the seed farms has given an average of 40·3 % of lint. If it were possible to substitute *rosea* for the *Katevilayti* now grown, the higher ginning percentage alone would in a normal year result in an increase in the Central Provinces and Berar of 51,000,000 lbs. of lint. We believe that this is possible and that to effect it merely requires time and organisation, as the cultivators every where are clamouring for the seed.

12. At present prices there is no possibility of growing bani, except at a comparative loss, owing to its low ginning percentage. An effort has been made to raise it by selection, and one strain has been improved to the extent that it gives 29 per cent. of lint ; but even at that it is hopeless to think of growing it at a profit.

13. *Rosea cutchica* is slightly inferior in the quality of its staple to *rosea* and gives from 2 to 3 per cent. less lint.

14. *Malvensis* and *vera* give about the same outturn of lint, which is nearly equal in quality to that of bani. There is great variation in the quality and percentage of lint of different strains of *malvensis*, and it is therefore

believed that there is much scope for that reason for its further improvement.

15. At present prices, it pays to grow *buri* in fields where *deshi* cotton is subject to wilt disease and this is being done. Many cultivators who have tried it, have found that it pays, too, when grown in the well manured *khari* soil found near the villages. Of *buri* the new variety recommended for certain classes of soil, seed for 3,000 acres was distributed in this way last year : while this year twice that quantity will be dealt with.

16. Plant-to-plant selection of all these different cottons has been carried on continuously during the last five years and all the seed sown on the experimental farms has been propagated in each case from a single mother plant. The seed of these selected strains of *rosea buri* and *malvensis* is supplied to the different private seed farms whose owners in turn distribute it to the cultivators. From the experimental and seed farms 120,000 lbs. of seed were distributed last year ; about 150,000 lbs. will be distributed this year ; while next year, if the crop is a normal one, the distribution will run up to at least 200,000 lbs. There are already 41 of these seed farms in existence, scattered over 16 taluqs. Selected seed will continue to be supplied to these from the experimental farms, where selection is carefully supervised. The owners of seed farms fix their own rates and arrange for the sale and distribution of their own seed : the Department of Agriculture advertises it for them as widely as possible. Till this year, the selected seed for these farms was supplied by the Department free of cost ; as they have now become popular institutions, and as the merits of seed selection are becoming more widely appreciated, those who have started new farms this year have agreed to pay the full market price for the Department's selected seed. All these farms will be run on that footing next year. They will therefore

be entirely self-supporting in future, and the duty of the Department regarding them will consist in supervision with the view of ensuring honest dealing, in widening the distribution of seed of the variety specially suited to the locality, in keeping in touch with the owner, and in popularising and extending the system of distribution to other centres. The system is based on the assumption that the owners, nearly all of whom are enlightened members of the Agricultural Associations, are sufficiently honest to sell as selected seed only that which they have raised each year from the improved strains supplied by the Department. The seed supplied to them being of pure strains, it necessarily follows that, in the event of their adulterating it with their own inferior seed, their sins will find them out in the mixed crop raised from it, and that they will soon lose any reputation they may have gained as seedsmen. No such case of adulteration has yet been reported, and we believe that, by exercising efficient supervision, we are in a position to put an end to the practice, should it arise.

17. The greatest difficulty of all is that of getting the *kapas* ginned without injuring the quality of the seed. Up to the present nearly all the seed has been hand-ginned. As these farms have increased in number, however, great difficulty has been experienced in getting sufficient labour at the proper season. During the picking season, *i.e.*, from October till January the women coolies are employed in the juar and cotton harvest, and the seed-grower has therefore to store his *kapas* till the slack season comes round which coincides with the beginning of the hot weather. By that time the price of lint has generally fallen : moreover, the buyer reduces the price still further, on the ground that the cotton has been hand-ginned and is therefore 'dirty.' The grower has still another difficulty to contend with : in the event of plague breaking out in

his village, flea-infected plague rats sometimes harbour in the *kapas* and die there. In the light of these facts it has been decided to get the work done in future by power rather than hand gins. All the seed cotton of the Experimental Farm, Akola, has been ginned for the last 4 years on two Platt's gins driven at a slow speed by a small 5 H. P. steam engine. The germinating percentage of the seed ginned in this way is as high as that of hand-ginned seed. Arrangements are now being made to set up similar ginning plants—but with an oil instead of a steam engine. We thus hope to have the whole cotton belt studded with hundreds of village seed farms, with small central ginning factories here and there, capable of dealing with all the selected cotton grown thereon. These farms will also continue to serve as centres at which seed of new varieties will be grown for distribution. In the rice tract where the rainfall is high it was done distinctly better than *deshi* cotton.

18. Trials are at present being made of gins driven at different rates of speed by the Gardner Oil Engine with the view of ascertaining the Brake Horse Power required to drive a gin at different speeds, and the extent to which the damage done to the seed at the time of ginning can be reduced by running the gins at a lower speed. Mr. Low, the Director of the Department hopes to have a well-organized system of seed farms all using the same type of ginning plant; and he has agreed to maintain a Departmental mechanic who will spend his whole time in setting up these plants; in training men to drive this one type of oil engine, *viz.*, the Gardner, and in executing repairs, when necessary.

19. We believe that a great and permanent improvement of cotton can be effected by working thus from within. The trial of exotic varieties will be continued, but here the difficulties in the way of attaining success are greater

owing to the soil and climatic conditions being unsuitable for long season cottons. The rainfall of the cotton tract ranges from 30" to 45" annually, nearly all of which is obtained during the first three months of the growing season, *i.e.*, from the end of June till the end of September. After this the dry weather sets in and exotic cottons suffer from "red leaf blight". Sometimes, too, they are still further damaged by frost in December or January. Requiring as they do a longer growing season they are subject to forms of damage which our indigenous varieties, being earlier and hardier, escape. Of the exotic varieties tried up to date, *huri* is by far the most promising. It is comparatively early : it is, moreover, immune to wilt disease, and therefore meets a distinct want in this part of India, where, owing to continuous cropping with cotton, this disease in places is becoming serious.

A PLEA FOR AGRICULTURAL IMPROVEMENT,

BY H. C. DAS, ESQ.,

Dehra Dun.

Just when man took to the profession of Agriculture and began the improvement of soils by means of tillage tools we do not know, nor do we know the kind of the tools that were first employed. This, however, we know : the first written evidence of civilization includes in its work simple tillage operations introduced that the fruits of the field might be increased. The first simple tool may have been a shell from the sea, or a pointed stone from the mountain side, or, it may have been a sharpened stick : it matters not, for in time these and other kinds were succeeded by a crooked stick, which in time became modified, and developed into modern tools of tillage. We must not think that the cultivation of soil is a modern discovery. It is as

old as the practice of putting seed into the soil by cunning animal or man. It is a part of every civilization : of the ancient Hindus, of the Chinese, of the Egyptians, of the Greeks, of the Romans; it is older than history, even older than civilization—Daniel Webster says “when tillage begins other arts follow. The farmers, therefore, are the founders of human civilization.” This was proved in ancient Rome and ancient India, and is being proved at the present day in other countries ; but India is dead asleep and has to be awakened to the fact.

It is safe to say that Agriculture was the first profession of man when he settled in household life and I believe it has a grand mission yet to fulfil. In the first page of the Bible it is mentioned that God created man and told him to live by subduing the earth. In the beginning he did so and even to the present day he mainly depends upon agriculture. By no other profession one can be so free and independent of others. If one’s ideal is “plain living and high thinking” he can easily live in peace and happiness by leading the life of an honest and diligent farmer. Already there is a murmur all over the world for simple and peaceful life ; but it cannot be secured without agricultural improvements. The solution of many difficult problems of the human society and salvation of the whole human race greatly depend upon agricultural improvements. When we see the Emperor of Germany exhorting his people to improve the agricultural condition and the leaders of the United States of America looking forward centuries ahead to conserve the farm resources, it seems hopeful that the happy dream of the ideal kingdom of Jesus Christ may be fulfilled sooner or later, and his prophecy that the swords will be beaten into ploughshares and spears turned into pruning hooks may some day really come to be a fact.

The ideal of peace was preached in India ages ago, and our ancestors sincerely tried and succeeded in a measure to realise the ideal in their life. If now the people go astray and forget the ideal, who is responsible for that? Certainly the educated and the rich leaders of the land are entrusted with the sacred duty of upholding the ideal of a nation. By their high ideal the Indians conquered the hearts of the whole of the East and in a great measure affected the inner life of the whole world. There are signs that the world is gradually advancing towards that ideal. The world cannot afford to lose that ideal and the modern Indians cannot, for any reasons, run away from that and thus commit suicide. I would rather see them perish than they should lose their instinct and tradition. But to fulfil their destiny they must live and live honorably. For this my plea is to improve the Agricultural condition of the country. Majority of the population live on agriculture and still the agricultural condition is not so bad in any other country as in India. In the Western countries the educated, the nobility and even the spiritual ministers take active interest in agricultural matters while in this country the things are left entirely in the hands of the ignorant peasants, and the result is as could be expected. Unless the educated and the rich take sufficient interest and go to the field, the country is sure to go from bad to worse. The people of India have spiritual culture of thousands of years at their back ; if they can manage to have a decent physical existence it is not improbable that they will take a leading position in the parliament of nations in near future. With time the circumstances have changed. Their world is no longer bounded by three sides ; consciously or unconsciously they must be influenced by various forces, which are working all over the world. If they want to exist on the face of the earth, they must gird up

their loins to move with the time, or, they will be crushed down to earth.

Internal peace in a country is always followed by industrial prosperity. Fortunately the
Peace & Prosperity. Government has established peace, and life and property are secure everywhere. Some one may question the value of this statement, but for my purpose it is enough that there is security of life and property and any one can try to improve the situation if he likes. It now devolves upon the people themselves to try their level best to reap the benefit of the peaceful condition and improve the prosperity of the country. It is idle to expect that the Government will provide bread for every one. No Government in any country can do this. Government can establish educational and experimental institutions but the people must be ready to do the practical work, go to the field and mines and dig up wealth from the earth. Wealth is needed, at least to keep the body and soul together in proper condition, and that wealth has to be created. Empty stomach is the source of almost all the physical and moral diseases, and it is of the utmost importance to every one to keep himself free from these. There may be difficulties on the way to undertake other industries, but agricultural industry is easily accessible to all and capable of supplying provisions to satisfy the stomach.

BOYSON SINGS OF THE PLOW.

" I feed the people
 Eagerly wait on me
 High-born and low-born, pale children of want :
 Kingdoms may rise and wane,
 War claim the tithe of slain,
 Hands are outstretched to me.

Master of men am I, Seeming a slave,
 I feed the peoples, I, the plow.
 I prove God's word true—
 Toiling that earth may give
 Fruit men shall gather with songs in the sun.
 Where sleeps the hidden grain
 Corn-fields shall wave again ;
 Showing that while men live
 Nor seed nor harvest time ever will cease
 I prove God's words true, I, the plow."

Every country has a main industry suited to its particular natural conditions. If that main industry is well developed, side industries are sure to grow and stimulate the all sided activities of the people. It is unnecessary to discuss at length that India is pre-eminently an agricultural country and the agricultural condition can be improved to almost an unlimited degree. Why with longer seasons, better soils and larger water supply should the country lag behind others and be called the poorest, and even barbarous by some ?

But what are the present conditions? The rich and the educated consider it beneath their dignity to look towards agriculture. Consequently the agricultural condition is in the most primitive state. The country which discovered the science and art of agriculture more than 4000 years ago still uses the same little plough, does not even dream that there can be any improvement on that and never thinks of using any modern implements. Is it not a pity that Indian plough should be kept as a thing of antiquarian curiosity in the industrial museums of other countries? Almost every house-holder in this country has his holding to raise crops for his own consumption, but the rich and educated house-holder entirely leaves every thing in the hands of

his ignorant servants, who follow, the old routine as a matter of course, never thinking that things are liable to improvement or deterioration. Thus the soil is deteriorating, cattle are deteriorating and diminishing and the poor people are getting poorer every day. There is no system of manuring the land, selecting seeds and cattle, and careful breeding of live stock, &c. and these things cannot be done by the ignorant peasant without proper guidance and example.

The situation has become such that things cannot continue this way for a long time. It must be changed without delay. The number of the hungry and the unemployed are increasing day by day and they will either become dying beggars and criminals proving a menace to the peace of the society, or, they may, by proper care, be turned into wealthy tax-payers and good citizens leading honourable life and helping each other. One idle member of a society does not mean that that particular man's energy only is wasted, but he draws on at least half the energy of an earning member. The leaders should take note of these and try to solve the problem in time. If the rich and the educated show the way they can open an honourable career for the younger generations who are drifting hither and thither for want of work, and thus increase the wealth of the country. Some people think that all the unemployed should be provided with positions in Government Offices. Is it possible for any Government to create a post for every one in the country? who will then supply the fund? The problem which confronts us is not to change money from one's pocket to another's, but to create wealth. The resources and means for creating wealth should be improved. Once a grocer in America put up a notice in his store requesting his customers that they would kindly write their profession on the board kept for the purpose.

Capable tax-payers from the hungry & unemployed.

A minister happened to come in and he wrote,
 I pray for all : then came in a lawyer and wrote
 I plead for all : then came in an architect and wrote
 I plan for all : after all came in a farmer and wrote
 I pay for all.

This is the condition in almost every country and that unfortunate country is to be pitied where the people are blind to this fact. It is wiser to look facts in the face in time instead of slowly marching towards inevitable death.

If the agricultural industry is well developed in the country a class of gentlemen farmers will be created and thus the problem of the educated unemployed will become much easier for solution. The poor labourers in the congested areas can be drawn to these farms as labourers and their condition improved. Tea plantations have already shown that this is a fact. When the whole country will be full of different kinds of farms, the poor labourers will be a source of strength to help the industry. Besides, the people will find fields of employment in various other industrial works which are sure to grow side by side. Education is not given only to make office assistants, but to develop the faculties of man for enabling him to live a manly and honourable life. But the young people will need guidance and initiative at present.

Unless money is drawn from earth by mining and agricultural industries, commercial industries cannot thrive, and this is being actually felt in this country. First of all for commercial industries good buyers should be calculated upon, and then capital and good workers should be engaged. This cannot be expected unless there is a large population drawing money from natural resources. A lawyer may become rich but this means that some quarrelsome people are getting proportionately poorer. Thus a lawyer buying ten shares in a banking con-

cern means the proportionate loss of capacity in others. Moreover one who successfully uses his brain and energy in one capacity is likely to be a better worker in another capacity than an idle person. This is the reason why commercial enterprises are not yet so successful in this vast country with an immense population.

There are large areas of land in the British Territory and Native States lying waste and waiting the plough. The Government and the Princes are anxious to have their lands cultivated. Utilization of unused materials. On the other hand there are thousands of young men wasting their energies almost for nothing. If the leading members of the country meet together and find some ways and means to utilize these two agencies (land and the young people) they will not only help these young men and the land-lords, but help the country, nay, the whole human race. I am sure the land-lords will be glad to get honest and industrious tenants to increase their income, and help any reasonable project for the purpose. The young men will need proper guidance and in some cases a little fund to begin with. This can surely be afforded by proper organization. The present is a golden opportunity. The Viceroy has declared that he will help to develop the resources of the country and so have some of the Provincial Governors. Some reliable project is sure to be patronised by them and with the help of the Princes and Nobles and sympathetic high Officials good results can be obtained in a few years' time. Possibly it is not generally known that the Government passed orders years ago to help the indigenous industries. It is for the people to turn the benevolent intention and help of the Government to good account.

This is the land of *Asrams* (hermitage) but we have lost the ideal. It has been Revival of the Institution of *Asram*. revived in other parts of the world.

There are farms in the Western countries which remind one of the Asrams of Ancient India. The ideal of Asram should be revived. The cultured people will live in farms by their honest labour enjoying health of body and mind. They will use their spare time in intellectual and spiritual culture and thus follow the footsteps of the Rishis (sages) of holy memory. Instead of wasting their time and energies in brooding over wild ideas they will apply themselves to practical work. To be successful they will have to acquire self-control, self-respect and self-reliance and so become good neighbours to others and dutiful citizens of the world. Such farmers will study the problems of the preservation and improvements of plants, fruits, live stock, &c., like the farmers of the West. In short they will combine in themselves the East and West. In America the farmers are not always common labourers, but very often the University professors only re-iterate the experiences of the farmers.

In this country unfortunately there are people who have a sad prejudice about the dignity of labour. In words they declare that all work is God's work, feel proud of the Vedic Rishis and so forth, and still they do not hesitate to look down upon an honest labourer. Was not the Vedic Rishi a farm-labourer? He became a Rishi because he was a farmer. When an intelligent man lives free from any sort of friction, breathes the purest air, drinks fresh clean water, takes healthy unadulterated fresh food raised by his own hand, remains in constant touch with the bounteous nature, his clear undisturbed brain is capable of thinking highest thoughts and grasping divine truths, his simple pure heart bounds with joy and is full of thankfulness and adoration. In such a condition one is in the best mood to find his sweetest relationship with his Creator and his fellow beings. The Rishis of old were

simple farmers and their farms and cows were their main support. Agriculture was the means of livelihood and they used their spare time in intellectual and spiritual culture ; such were the Rishis of old Hindustan to whom the whole world is indebted. Why need we go so far back to vindicate the dignity of labour ? Even in the present day what do we see in other countries ? Even our King-Emperor, while a Prince, worked as a sailor, and a sailor's work is as hard as that of a farmer. Mr. Roosevelt, one of the foremost men of the world at the present moment, comes from a farm. Only the other day when he went to Norway, the Norwegian settlers of America proposed to erect a statue of Mr. Roosevelt. He asked them to make his statue not as late President of the United States but as a cow-boy what he was in his youth. President Taft's brother is a farmer and he is not ashamed of that. When he goes on tour he goes to his brother's farm for some days, and this item is published with other items in the official programme of tour as is done in this country when the Viceroy visits the Prince of a Native State. Some of the most distinguished senators of United State. of America are farmers. They delight to work in their farms in recess time. Like the Roman senators they leave the ploughs and come to the senate chamber to discuss serious state matters. Outdoor open air work balances our physical and mental capacities. It relieves and refreshes the overworked brain, increases the capacity and vigor of body and mind, and thus prolongs our life and the usefulness of our existence.

We might always remember with advantage the beautiful lines of Henry W. Longfellow :—

If thou art worn and hard beset
 With sorrows, that thou wouldst forget
 If thou wouldst read a lesson that will keep
 Thy heart from fainting and thy soul from sleep,

Go to the woods and hills. No tears
Dim the sweet look that Nature wears.

High personages in U. S. A. feel proud that they are capable of doing all sorts of work. More than 50% of their intelligent people live in farms and they are the backbone of the nation. Americans have made miraculous progress in agriculture and still they are strenuously striving to make further progress. In this country even the human beings do not care for pedigree, but there they have registered pedigree of horses, cattle, sheep, swine, &c. and even of grain seeds. Like pleasure gardens in this country, you will find magnificent farms around the large cities like Chicago, &c., owned by multi-millionaires. These are mostly model farms and in some the owners work themselves and encourage others. Who is a farmer there? The farmer is a laborer in his farm, a mechanic in his workshop, a leader or a minister in the church, a senator in the senate, a governor of a state and so on. His wife is a co-worker in the farm and at the same time a leader in the church and society. We know the root meaning of the Sanskrit word Duhitri (Daughter) but it has been forgotten here. It is a sight to be seen when the fairylike daughters of Western farms drive home the cows from the pasture and milk them like the Duhitas of the Rishis of old.

In Europe the ladies of even the Royal Families work in the kitchen gardens. Here the ladies consider idleness as the ideal of a happy life and thus being confined within the four walls waste their time and lose their health. They never know the pleasure of work. The people very often talk of the high ideals of the Bhagabadgeeta, but they forget the easiest and best maxim that peace is attainable through pure work. Any way it is better to work and live an honest life than to die a beggar or a criminal for the pretension of false dignity.

When the country will be adorned with thousands of farms equipped with fish ponds, orchards, gardens, cow and horse barns, granaries of grains, &c., that will be a brilliant day for the country. Above all when every body will be busy with his own duties, there will be no time for quarrel or jealousy, and then there will be no disturbance in the society.

The words which Cicero puts into the mouth of Cato give a fine picture of the ancient Roman enthusiasm for agriculture. "I come now to the pleasures of husbandry, in which I vastly delight. They are not interrupted by old age, and they seem to me to be pursuits in which a wise man's life should be spent. The earth does not rebel against authority, it never gives back but with usury what it receives. The gains of husbandry are not what exclusively commend it. I am charmed with the nature and productive virtues of the soil. Can those old men be called unhappy who delight in the cultivation of the soil? In my opinion there can be no happier life, not only because the tillage of the earth is salutary to all, but from the pleasure it yields. The whole establishment of a good and assiduous husbandman is stored with wealth, it abounds in pigs, in kids, in lambs in poultry, in milk, in cheese, in honey. Nothing can be more profitable, nothing more beautiful, than a well-cultivated farm." The passion of the ancient Romans for agriculture survived very long; and when at length their boundless conquest introduced an unheard of luxury and corruption, the noblest minds amongst them were strongly attracted towards the ancient virtue of the purer and simpler agricultural times. Several facts in Roman history afford convincing proof of the devotion of this ancient people to agriculture in their best and happiest times. Perhaps it is not too much to assert, that many of those qualities which fitted them for conquering

The Romans and
Agriculture.

the world and perfecting their so celebrated jurisprudence, were acquired, or at all events, nourished and matured, by the skill, foresight and persevering industry so needful for the intelligent and successful cultivation of the soil.

But successful cultivation of the soil requires wide
Successful awake intelligence and broad know-
farming. ledge. Farming is a business, and the
 successful farmer must be first of all a business man. He follows his vocation primarily for money he can make, and like other business men should aim to get the greatest possible returns for the money and labor spent. It is not enough simply to grow crops, but they must be so produced as to yield a profit on the capital invested. Agriculture is not merely a business, but an art as well; the art of producing plants and animals that are useful to man. A real knowledge of farming necessitates a knowledge of the principles upon which the art of agriculture is founded; for an understanding of these principles is essential to an intelligent and rational practice. This cannot be expected from an ignorant peasant, and if the farming fails we should not blame the soil.

Pope sings :—

“Where grows ?—Where grows it not ? If vain our
 toil,

We ought to blame the culture, not the soil.”

This beautiful saying applies equally to plants and human beings and specially to the present condition of this country.

For successful farming two things are very important—good tillage, and maintenance and improvement of the fertility of the soil. Tillage increases feeding ground for roots, and is the most efficient means of assisting nature in the conversion of unavailable food into forms that the plant can use, it hastens chemical changes in the soil by bringing together substances having different chemical

properties and thus enabling them to act upon each other and converting them into available plant food : it aerates the soil and introduces oxygen to the roots, increases amount of available water and helps to conserve the moisture of the soil, destroys weeds, and so forth. Certainly it requires intelligence and education to understand these principles and work them carefully and efficiently.

It is a matter of common experience that continued cropping results in a loss of fertility. In

Fertility.

the beginning the productiveness of the rich virgin soil seems unlimited and for years large crops are produced with apparently no decrease in fertility. Sooner or later, however, the crops begin to diminish, gradually, to be sure, but unceasingly, until at last the yield becomes so small that it no longer pays for the cost and labor of cultivation. This state of affairs comes about more rapidly if the same crop is grown continuously on the same field as is done in this country. The soil, however, can never be completely exhausted ; it is exhausted for all practical purposes when the crop produced ceases to be profitable. The first question that naturally suggests itself is, why does the productive power of the soil diminish ? It is evident that the virgin soil must have contained large quantities of substances that were necessary to vigorous plant growth and these materials were removed when the crop was harvested. Something should be done to maintain the fertility, and for this purpose two things are necessary, first, to make additional quantities of the potential food available ; second, to add something to take the place of the materials removed with the crop. Tillage, drainage, irrigation, fallowing, green manuring and rotation, &c., are methods of changing potential plant food into available forms, and to maintain and increase the fertility, some form of fertiliser must be used,

Barn-yard manure is the oldest and is still undoubtedly the most popular of all fertilizers. Unfortunately the dung in this country is largely burnt as fuel, and the urine which is as valuable as dung is entirely wasted. We may deplore the burning but it is inevitable where wood is not available. In some parts of the country a kind of fuel tree is grown which matures in a few months' time. This might be extensively grown in other parts of the country. The Americans use fireless cooker for cooking various articles which require boiling for some time. In those parts of the country where rice, dal, &c., are largely used these fireless cookers can be introduced with great advantage. Every house can have a fireless cooker at a trifling expense. The problem of manure is harder in China and Japan, but the Chinese and Japanese are proving themselves equal to the task. The Chinese carefully collect even the smallest particles of grass, leaves, vegetables and food articles, &c., not to speak of dung, urine and night soil, and take these to the fields. If you go to a Chinese oilman's house you will find the boy, who is watching the bullocks working the oil mill, always ready, with a can in his hand, to hold the urine which the bullocks may happen to pass, and collect it in a jar. Night soil is sold in public markets as an article of merchandise and it is regularly spread in the fields. The Municipality of Shanghai earns more than a lac of rupees annually by selling their night soil instead of spending money for removing that. The Chinese use canal mud as manure, and this way they add fertilizer to the soil and at the same time keep the depth of the canal to its proper level. In this country materials are not yet wanting, but systematic manuring is almost entirely neglected.

Dairy farming is one of the most useful occupations

Dairy farming. in agriculture for retaining and restoring the fertility of the soil by supplying the valuable barn yard manure, &c. But, unfortunately, in this country the higher class people do not take any interest in this. Some of them keep fine horses in their stables and dogs in their kennels, but they never think of preserving and improving the breeds of cattle either for pleasure or for profit. They should imitate the example of the magnates of Europe and America. When the "White House" cow "muley" died last year the papers of the United States of America noticed the event as is done in the case of some prince in this country. The bulls and cows are sold at fabulous prices in U.S.A. There are thousands of Dairy farms and butter factories all over the country, and it can be easily imagined how many workers are engaged in these and how much money is raised. Theoretically the cow is looked upon as a goddess in this country but one has to go to America to see how the mother cow is taken care of. The barn is lighted with electric light, supplied with purest water, kept clean like a temple, and the cows are fed with balanced rations scrupulously selected. Cows producing 100 lbs. of milk a day are not rare. A large number of people in this country are vegetarians and they need pure milk and butter, but still how many are there who think about increasing the quality and quantity of these articles ?

The finest cows in the West come from the two little islands Jersey and Guernsey in the British Channel. They have been brought to present perfection by organizing Royal Agricultural Society, Farmer's Club, &c. In 1834 the Royal Agricultural Society of Jersey was formed and held its first show : The result of this was :—

(1) Inspiration to breed better cattle.

(2) To improve the production of the cattle. Since then the improvement has continued in various ways.

Here the shows are held for mere show, but in the west shows are held with a definite purpose: to remove the defects and find out better methods to improve the object shown. Such shows are held throughout the year in different parts of the U. S. A. In this country too, fine cattle are still available in the Punjab, Sindh, Kathiawar, Mysore, &c., and they can surely be improved by proper care and management. Now-a-days it is hard to get unadulterated *ghee* or milk in towns and cities. Hundreds of dairy farms can be worked with profit around large cities like Calcutta, Bombay, &c. The rich people might undertake such work with pleasure and profit, and obtain blessings of their countrymen. For successful dairy farming one will have to raise good feed such as clover, alfalfa, &c., and these things will help another fine industry to grow, namely, *Bee culture*. At present honey and wax are collected from jungles: but if a systematic method is introduced it will furnish an occupation for both men and women.

Bee culture.

With growing business in tannery, &c., the demand for wax is sure to increase, and when the people will take honey as a regular food article as is done in the West there will be a great demand for honey. Apiary is a fine industry and it supplies both amusement and money.

In America one hears a great deal about dry farming.

Dry farming.

By this method the Americans raise rich crops in the regions where the annual rainfall is 15 inches or less. It should certainly be tried in the dry areas of this land. Dry farming is nothing more than good farming. Its real meaning is good tillage, it means water-saving by good ploughing and frequent effective cultivation; it means crop rotation for its sanitary effect: it means humus for the soil for its many sided benefits. Dry farming means specially these things: water is to be absorbed, water is to be saved, and plants are

to be adapted to their surroundings. Average farmer however rarely comprehends what land management means. He ploughs of course ; but mere ploughing may mean tremendous moisture loss, unless cultivation be given—the mulch making kind—so that the capillary tubes of the top and under soil may be disconnected, that the water in the reservoir beneath may not get out into the atmosphere above.

Knowledge and guidance are needed for carrying these principles into practice. Individuals here and there cannot do this but systematic organisation is necessary. Agricultural co-operation as is represented by certain primitive system of mutual assistance at times of ploughing and harvest is not uncommon here, but association of the European type for the purchase of seed and machinery or for sale of cattle and produce are practically unknown. By co-operation many of the modern machineries can be used, the boundary mounds between the small fields can be done away with and some of the land thus saved may be utilised for pasture land ; wells, tanks and wind mills can be constructed, until the canal systems are extended, live stock improved, suitable light machineries devised, a general stimulus given to agricultural industry, and a new spirit instilled into the drooping hearts of the poor peasants. If the rich and educated bring their wealth and culture to bear upon agriculture, the country's condition can be changed in a few years' time and the demons of poverty and famine driven out of the country. This may be a dream, but a happy dream to be sure. Great Lincoln said that we are not bound to succeed but we are bound to do our duty. Should we not try to do our duties to our poorer brethren and to our mother country ? Let us try to perform our duties to the best of our light, and need not be anxious

for the result. H. H. The Maharaja of Jeypore founded the Indian Peoples' Famine Trust with a very generous gift for affording relief when a famine occurs. Is it too much to expect that the other Princes and the people may found a fund for preventing famines and stimulating the material prosperity of the people? About half the population of this country are inactive and dependent on others. If half the population could earn one rupee more per head yearly they could feed at least one crore of the people. Certainly this is not impossible.

A grand opportunity is coming forward and we should make the best of it. H.M. the King Emperor is coming personally at the Cor-
 Delhi Durbar. nation Durbar to be held at Delhi. Probably there will be various exhibitions held at the time. The Princes and people should meet at an agricultural Durbar to find ways and means to improve the agricultural condition of the country, an agricultural show should certainly be held and grains and cattle collected from the different parts of the country. This is a grand opportunity to stimulate agricultural improvement and if this can be done, the heavy expenses for the Durbar will be amply justified. If an agricultural Durbar can be arranged H. M. the King Emperor may be approached with a prayer to grace it with His august presence. The presence of the Ruler of the Empire and the Head of a nation, which is at the root of the modern civilisation will give an unprecedented stimulus to the industrial regeneration of the country. Macaulay said on a historic occasion that it will be the proudest day in the British history when the people of India will ask for English political institutions. I say it will be the proudest day in the annals of the British nation when the people of India will acquire material prosperity under the fostering care of the British Government.

I earnestly ask the leaders of the land to open their eyes. Civilisation does not consist in idleness nor in the multiplicity of motor cars. But the highest civilization consists in the realisation of oneness of the human race. This theory was propounded in this country centuries ago, but in practice it is nowhere in the world so cruelly neglected as in India. Pray, help your poorer brethren. They want bread. Do not give them mere words. Remember that by helping the poor cultivators you help yourselves. Our agricultural country has one advantage over commercial countries. In the former the wealth is likely to be more equally distributed than in the other, and though there may not be many millionaires, the people are likely to live more contented. This is certainly an advantage, and I would earnestly ask one and all to help the agricultural cause.

For this purpose an agricultural association composed of the prominent members of the country should be formed which will spread agricultural knowledge throughout the length and breadth of the country and by direct instruction and distribution of literature find out means for creating a class of educated farmers, &c. Such associations were formed in Great Britain in the 18th century in which the high and low joined and gave an impetus to the agricultural industries. England or the British Isles have thus become the birth place of modern western live stock and agricultural knowledge. In America, besides the famous Universities there is no end of experimental stations and associations. Professors and others always go round the State instructing the people and helping in the application of practical methods. The co-operation of officials should be solicited and I am sure such co-operation will be forthcoming. Indirectly this will lead to better political and social condition, and do away with all sorts of misunderstanding.

I cannot do better than finish with the noble words of Jethro Tull, the Father of Tillage: "Men of the greatest Learning have spent their Time in contriving Instruments to measure the immense distance of the stars, and in finding out the Dimensions and even weight of the Planets: They think it more eligible to study the art of ploughing the sea with ships, than of tilling the Land with ploughs, they bestow the utmost of their skill, learnedly, to invent instruments of destruction of their own species, in the bloody Art of open war. Some waste their whole lives in studying how to arm Death with new Engines of Horror, and inventing an infinite variety of slaughter: but think it beneath men of learning (who only are capable of doing it) to employ their Learned labours in the invention of new (or even improving the old) instruments for increasing of *Bread*."

COTTON CULTIVATION.

By H. R. PITKE, Esq.

Prices Current Inspector, Akola (Berar).

With regard to the antiquity of cotton plant, there is satisfactory proof that one kind at least was known in India and that another existed in America when it was first discovered by Columbus. These two are distinct species as is the case with the majority of plants found in the old and the new worlds.

India being a civilized country and having had a literature more ancient than that of any other country in the world, it is certainly interesting to find out the period when cotton was first mentioned, either in its natural state or as used in the art of weaving. The earliest mention made, which we know, of this substance is in that most ancient Digest of Law, the Institutes of Manu, written about 800 B. C. There it is said

that the sacrificial thread (जानवे) of the Brahman must be made of cotton. This indicates that it must have been long in familiar use by the Indians. Cotton and cotton-cloth, wicks, etc., etc., are also mentioned in old sanskrit classical literature.

Price of cotton depends on the length, strength, softness and fineness of the fibre. The varieties of cotton are modified by colour and cleanliness. The different kinds of cotton differ more or less from each other in quality. The samples of the same variety may differ from each other according to treatment, keeping and other circumstances. Thus cotton of the 2nd or 3rd picking is considered superior to that of the first and last picking.

These varieties are divided into the following orders :—

- (1) Inferior, (2) ordinary, (3) middling, (4) good middling, (5) middling fair, (6) Fair, (7) Good fair, (8) Fine, (9) good and fine.

The present known varieties are given below :—

- (1) Good staple *i. e.* (long staple—best Jari and Bani).

A	{	(a) Superior fine
		(b) Fine
		(c) Strict fully good
		(d) Fully good
B	{	(a) Strict good
		(b) Good
C		Good fair

- (2) Fair staple (less than the long staple) Inferior Jari, Bani and Hybrid.

- (3) Moderate staple (short staple) Katel, Havari, Vdki.

- (4) Belaiti staple. (This is very rarely found in Berar.)

BENGAL NAGPUR COTTON.

The kinds of cotton are named in commerce after the places of export and other circumstances.

The long staple cotton is generally used for twist and short staple cotton for the weft.

Its names are :—

East Indian Cotton.—It is known by the names of

Surats, Madras, and Bengal, while the Surats is the general term for all Indian cottons which are bought when the American cotton is dear, cottons of Surat, Broach, and Berar are all named as Surats the reason being that cottons from these places form the same esteemed variety. Bengal cottons comprise those from United Provinces, Agra, Nagpur and inferior cotton from Berar.

Sea-Island Cotton.—Best of all. Length $1\frac{1}{2}$ inch. Its diameter is $1/2000$ of an inch.

Upland Cotton.—Its diameter is $1/1400$ of an inch.

Egyptian Cotton.—It is next to the Sea-Island cotton. Its staple is $1\frac{1}{4}$ " to $1\frac{3}{4}$ " in length and its diameter is $1/1500$ to $1/2000$ of an inch.

West Indian Cotton.—Its diameter is $1/1000$ to $1/2000$ of an inch.

South American Cotton.—Length $1-1/10$ " to $1-1/5$. Diameter is $1/1500$ to $1/2000$ of an inch.

Mediterranean Cotton.—It fetches very high price.

These cottons are cultivated in Asia Minor, in Greece, in Sicily near Naples and in Malta, and other adjacent countries.

There are three botanical orders of cotton in Berar:—

(General order) (Species.)

Gossypium—Herbaccum (Nimari).

Do. Neglectum (Jari).

Do. Indicum (Bani).

Cotton belongs to the order of Malvaceæ the most important group of plants yielding fibre.

With regard to Indian cotton it is said that although well fitted for purposes of hand weaving etc. (as Dacca Muslin) when spun by the delicate fingers of the Indians (Hindus) it may yet be unfit for the iron handling of Machinery. The weaver of the Southern Provinces depends for a part of the success of his manufacture upon the softness of his climate, while the Mohamedan of North-Western India immures himself in an underground work-shop of which the air is artificially

Nature and condition.

moistened for the purpose of producing the beautiful fabrics. The demand for Indian cotton will mostly depend upon the quality brought to the market. It is well known for its good qualities about which Mr. Bazley says that "the Indian cotton is always of a rich creamy colour and for its colour it is frequently used as mixture to improve the colour of the worst or low American cotton. It (Indian cotton) takes some dyes better than American cotton and the swelling of cotton thread in the process of bleaching can be attained by the mixture of the Indian and the American cottons referred to above. By that mixture cloth becomes more attractive in appearance. This has been fully known to the Indian weavers. The thread of cotton produced in South-East swells in bleaching but not so much as the Hindusthan cotton. The thread in the West and North-Western countries swells in bleaching more especially if it be hard twisted." These facts do not prove that Indian cotton is fit for English Machinery owing to its short fibre. Its quality has therefore to be improved and efforts in that direction are being made. It is said that Surat cotton is also a little inferior to that of America.

The prices of these varieties are :—

Surats.		America.	
1 lb yielding=12 oz. yarn.		1 lb yielding=13½ oz. yarn.	
3d.	3½d.
3½d.	3¾d.
4d.	4½d.
4½	4¾
5	6

It has already been stated that Surat cotton means Indian cotton. It is equal in quality to middling upland ; it is produced in Gujarath and fetches more price than cotton produced in any other part in India. Mr. Turner (President of the Commercial Association of Manchester) says in 1847 "I do not think that there will be a very great increase in the importation of Indian cotton if the quality remains of an inferior description but if cultivators can improve the quality

of Indian cotton so as to compete with the American cotton in the market it will never fall off." While Mr. R. W. Crawford, a Bombay merchant took a view contrary to the great spinners of Manchester for he stated that "it is a question more of reduction in price at present than of improvement in quality." Lancashire spinners purchase Indian cotton for spinning to the exclusion of the American cotton if it was cheap enough. If the Indian cotton is sold much cheaper then it is fit for Machinery and its quality becomes sufficiently good for spinning purposes. Cottons of Surat and Broach Districts situated as they are close to the sea-coast are considered superior in quality to those of the far distant tracts in the Nizam's Dominions. Mr. Chapman, Manager of the G. I. P. Railway Company states that "cotton of good quality for English use is always to be had in Berar (300 to 400 miles from Bombay. at about $1\frac{1}{2}d.$ to $1\frac{3}{4}d.$ $1\frac{1}{2}d.$ per lb. The quality of this cotton is such that at a certain relative difference of price (averaging about 15 per cent. less for Indian than American)." Some thirty years ago we had surely this cotton but it is now extinct. We find a plant mixed with Havri which probably represents the old type of Berar Jari.

It becomes an important fact to ascertain the causes which have lowered the rates of Indian cottons :—

- (1) Dirty state in which cotton is sent to market.
- (2) Inferior cotton is mixed with a superior kind of cotton by a process called "flogging."
- (3) Adulteration with cotton seed, fine sand, powdered salt, cowdung, night dews, *i.e.* moisture, &c., &c.

Cultivators are not solely responsible as they sell uncleaned cotton by carts but the dealers in cotton are mostly to blame in this connection. Sometimes it happens that some dealers advance sums to the cultivators as a help to them for sowing, weeding, &c., by fixing price at a low rate. The dealers get cotton in a raw state from cultivators who gather it very carelessly from the plants, stack it in a pit or kanang in which it changes its colour by exposure to the night dews and hence it fetches less price than American cotton

Dharwar cotton is called "Coompta cotton." With regard to that cotton Messrs. Mercer and Blaunt, American planters complained that the Ryots have all cotton in the field until the whole is ripe and they make one gathering of it (one picking), then get together the fresh and the old, making no distinction between the cotton and dirt. At present no selection of cotton seed is made for sowing; because the increase in industries, *i.e.*, gins, presses, &c., &c. has told on the old working and the seed now used is received from the gins of which some lose the germinating power as the noses of the seed are mostly cut off. The improvement in this connection is dealt with further on.

Three principal kinds of soil are given to cotton cultivation generally:—(1) Black—(*regar* or *basaltic*) soil, *i. e.*, pure black. Its subdivisions are:—

Morand—Black dark—brown soil.

(2) Rankar or grey Kunkary-black but not deep, having lime substratum, lime nodules. (Laterite rock and nodular lime stones) land.

(3) Brown kunkary soil—containing laterite and having reddish stony surface. (Khardi, poor and shallow dark soil with sand). Their description is as under:—

(1) Black soil (*carsal*). It is of a loose friable nature varying in depth from two to five or six feet or sometimes to 12 feet. Its surface after a heavy rainfall becomes dry and hard about 9 inches in depth but the lower portion of it holds moisture up to the depth above referred to for about a month and half. All sorts of crops grow on it. It is considered as the best and the most fertile soil. The roots of the plants grow to a great depth. It raises the best cotton, &c., &c.

(2) Black and sandy soil. (The *Veppal*)—The difference between the first and this soil is in the depth varying from two to four feet. Its upper surface becomes dry after the rainfall. It retains moisture up to a month only. It is a little less fertile than the first one. It is otherwise called *kalur*. It produces cotton, rice, black til, gram, &c.

(3) Clay soil (Poppel). Its depth is from two to three feet. Its surface becomes dry after fall of rain but it keeps moisture underneath for about a fortnight or so. It is not very fertile. It produces common cereals, castor seeds, katki, kodo, light sort of juar, &c.

(4) Red soil (Shevel). It is of a loose nature. It contains granite. Its depth is from one to three feet. After rainfall its surface becomes dry soon. Moisture is retained in this soil for less than a fortnight. It is a poor soil as water is freely drained with the result that little moisture remains and hence it requires rain oftener while the black soil during the first monsoon becomes caked at the surface. Cakes are required to be broken in order to preserve moisture and hence the advanced cultivator would always drill the seed in, instead of broad-caste leaving sufficient space between the lines and the plants so as to obtain facility of inter-culture, weeding, handling, &c. The drainage from red soil is useful to the black one. It is not fit for cotton. But now-a-days people use it even for cotton.

(1) A saline atmosphere is necessary to the production of good cotton and (2) certain degree of moisture in the air is essential. (3) The dryness of air is greater in tracts far away from the sea-coasts. These circumstances are found in the Berar, and its soil and therefore cotton grows here.

Other sub-classes with their names are :—

Lawan or low lying land has power of retaining moisture.

Pathar or land lying high or on slope and hence it is liable to dry up quickly.

Wahur or land cut up by water channels or ravines.

Ran or land lying at a distance from the village and liable to damage by wild beasts.

Bandhia or land embanked with small bank or bundba.

Appashi or irrigated land or fields.

Attention must be paid to climate suitable for cultivation of cotton. It grows well on the tracts where the climate is considerably dry.

Climatic effects.

The outturn of cotton crop is not dependent so much on superiority of soil as on the influence of climate. Good soil and favourable climate will produce the best cotton. Poor soil and favourable climate will give equally good result though the quality may somewhat be affected. Unfavourable climate and poor soil will produce inferior quality and deficient quantity.

Berar climate. It is salubrious though hot. There is jungle though in patches on the sides of the two mountain ranges that lie to the North and the South. Much of it however has been cut off.

Cotton seed is sown by means of Tiffan with three or four other minor crops. One acre of land requires from 4 to 8 seers of cotton seed. It varies according to the manner of sowing, *i. e.*, thick or thin sowing. In Broach, the Southern Mahratta country and in Berar it is sown by drills or Surata (a hollow bamboo tube). The best season for sowing is after the heavy rains of the South-West Monsoons. Excess of water is injurious to the fresh planted seed and the young plants. Sometimes seed is sown before rainfall, *i. e.*, in रोहिणी नक्षत्र Rohini Nakshatra. The time of sowing in Berar is :—

Name of District.	Approximate dates.	
	From.	to.
Akola.....	1st June	17th July..
Amraoti.....	5th May	3rd do.
Buldana.....	25th do.	5th do.
Yeotmal.....	10th July	31st do.

Sowing is followed by Wakbar by which seed is pressed in to the ground. It is sown by women in some places and in some places superstition goes so far as to say that if pregnant women sow the seed, it yields a good harvest. When plants germinate and commence putting forth a third leaf they have to be thinned. Hoe or Wakhar is used to scrape away grass and weeds weekly and it is made to follow plough lines and draw the mould around the roots but care has to be taken

that the plants are not chopped or cut off. This is called "Daura" and weeding by hand is called "Nindan."

Topping—This is not followed in Berar or elsewhere in India. But I think, it should be brought into practice. It should begin from the fourth month.

If cotton is singly sown, fair proportion of it is obtained but it is generally sown with tur, moong, urid, etc., etc., in proportion of two lines (Tas) of tur to every 10 or 12 lines of cotton. It is said that Tur plant gives shelter to cotton and protects it from winds; and it is in fact grown as a catch crop in order that the pest of cotton may be attracted to it and thus save cotton. But the idea is that all the plants should be uprooted and burnt after the cotton is removed.

Cotton seed is first well rubbed with cowdung or earth and then after drying, sown with a drill or Tiffan. If it is not rubbed with cowdung or earth, the lint will not allow seed to pass through the drill freely with the result that the sowing will be useless.

There are two kinds of cotton in Berar, *viz.*, Jadi and Bani. The Bani cotton has strong and long staple silky in touch and Jadi has stronger fibre and shorter staple than the Bani cotton. The former commands more price by three or four rupees per bale of 400lb. than the latter. Jadi is produced in brown, grey and yellowish soils which are lighter than the black soils. The Jadi plant is 5 or 6 feet in height while Bani plant is 7 or 7½ feet high and grows in the black soil. The spread of branches of Bani is from one to two feet while that of Jadi now found only as a mixture is two to four feet. Jadi and Bani plants have large flowers with yellow petals changing to crimson inside near the calyx. The leaves are palmate or divided into three or five segments towards the stalk. In the shorter staple cotton varieties the segments are much more deeply cut than in those of long staple. Bani has a staple of $\frac{3}{4}$ th of an inch while Jadi has a staple of $\frac{1}{2}$ to $\frac{3}{4}$ th of an inch. Havari, Katel, Vilayati being lately introduced have small thorns at the end of the pods. This variety has been

identical to Jadi but has been deteriorated owing to ginned cotton seed which is prepared now-a-days as hand gins or charaks have disappeared. Each plant has on an average 20 to 25 branches and each branch has three or four pods.

A Berar Jadi field now-a-days roughly consists of yellow-flowered plants with broad whed leaves. 20 per cent.

Yellow flowered plant with narrow whed leaves 10 per cent.

White flowered plant with broad whed leaves. 15 ,, "

Do. with narrow whed leaves. 55 "

Upland Georgian, deteriorated form ... 06 "

Bani thrives in cooler climate of plateaus but does not grow in the hot climate of the plains. It is sown about 3 weeks later than Jadi and thus stands more in need of moisture. The lint of Bani will fetch at least 25 per cent. more than that of Jadi.

The harvest times in Berar for the cotton crop are given below :—

Name of District.	From	To
Akola	5th October	28th February.
Amraoti	6th November	31st January.
Buldana	1st do	1st March.
Yeotmal	20th October	28th February.
Melghat	1st November	30th November.

Perennial Cotton.

The following are the chief factors of this cotton :—

(1) Soil, (2) climate, (3) culture, (4) cleaning.

(1) Red brown loams or any silicious or calcarious soil, fertile in moderate degree is the proper and fruitful soil for this cotton.

(2) The Sea Coast climate is preferable.

(3) Seed should be sown or young plants should be set in rows of at least 8 feet apart.

(4) Cleaning—cotton should be gathered carefully when thoroughly dried. Dirt and other impurities should be removed before sending cotton to market.

The following are the insect pests:—

“Chemille” ravages the plants. It generally consumes leaves very soon. It is about an inch or inch and a half long. Its back and sides are of a glossy black. A single line of white runs down the whole length of the back at its middle, and dull white lines are seen at each side of the single line and running in a direction parallel to it. The belly is of a whitish yellow colour and covered with soft downy hair with bristles which are short and black.

Caterpillar of the cotton-moth or *Noctua xyliua*—It makes its appearance in August full-moon. It resembles the candle moth which deposits eggs on leaf a night or two before the full moon. They hatch in a few hours. The eggs are so small that they cannot be seen with naked eyes.

Cut worms or grubs.—They appear in cold weather and destroy the young plants. They have copper metallic colour.

Red and black bugs.—They destroy fields after fields. They cluster on leaves or boll. They extract juice of the seed leaving the capsules blighted and hard and have yellow or red colour with a black diamond mark on the wings and some white lines on the surface. They are known as Jhangu or Lalkiri which lay eggs on soil or boll.

Boll or bore worms.—They live on pods, seeds of cotton and prevent bolls from ripening.

Noctua xyliua (2nd sort).—It is a very old genus of moths. It comes out when there is a long break in rains and when the sky is cloudy. It is called green fly or Telu mowha, mewa, &c.

Moth.—When cotton plants have a shining appearance they are said to be attacked with moth. These insects feed on leaves and thereby the growth of the plant is stunted. They are called “Mowala.” They appear in damp and cloudy weather.

There are 16 sorts of insects known up to now which are the pests of cotton of which eleven seriously affect cotton :—

Boll worms are of 3 kinds :—

- (1) Boll worm.
- (2) Spotted boll worm.
- (3) Pink boll worm.

- (4) Red cotton bug.
- (5) Caterpillar.
- (6) Stem borer.
- (7) Stem weevil.
- (8) Cotton leaf caterpillar.
- (9) Ball weevil.
- (10) Cotton bud caterpillar or cocoon.
- (11) Cotton-leaf hopper or leaf roller.

Some have wings and some have not. In Indian not climate they are viviparous, young being born as females without wings, are produced when food is plentiful, and within 10 days they spread in the field. The natural check is the beetles, lacewing flies. They are fed on flies which appear in cloudy and damp weather at the roots of the plants and then thrive.

Accidents arising from rains, winds, worms, &c., depend on uncertainties of climate &c. and Accidents, &c. devastation by insects. The former arise by excess of moisture in the soil, air, &c. whereby roots and plants perish. The latter depends on the dryness of the soil by a long break in the rains with dry winds. The plants become brownish and then perish and thus insects arise. *Hail-storms.*—They occur in February and March generally and destroy crops.

(1) The infected leaves, stems, branches, &c., should be cut off. Lime with sulphur should be Remedies and preventives for insect pest, &c. sprinkled.

(2) Light lamps should be placed in fields to drive away the moth.

(3) A mixture of sugar and rum should be deposited with brush in some places in the fields or the liquid of "gur" should be placed. The moths will gather together on these plants and then should be destroyed.

(4) Draught and grate enter into the boll and destroy it. Care should be taken not to allow the grate to go into the boll. If entered the boll should be picked off and dried in the sun and thus it dies. The boll is then all right.

(5) Kerosine and water (milk in some places is mixed with kerosine where it is available and less expensive) mixed together should be sprinkled with a syringe.

(6) Parasites enter the internal tissues of the plants and then there are no means of destroying them without injuring plants in which they live and iron sulphate may be used for roots in large doses without ill-effects and has, to a certain degree, power of killing fungi.

(7) Bhandi plants should not be grown in cotton as it gives food to the pests throughout the season which become pestilential to young crop of cotton next season.

Expenses, &c. Cattle, implements, farm-building, etc., are the items for expenditure.

At present the price of a pair of bullocks is Rs. 80 to Rs. 90 while in former times it varied from Rs. 60 to 80 per pair. The working life of a bullock is 6 years within which it works well up to 12 years and then declines in health. The bull is generally trained for ploughing after the fourth year. One pair can work 15 or 16 acres of land in black soil and 20 acres in hard or light soil.

" Annual expenses :—

Including Pay of the worker, }
(Mali) Cooli charges, etc. }

One Beegha of new land.

		Rs.	A.	P.
Government due as Land Revenue	2	0 0
4 Ploughings @ Rs. 2 each	8	0 0
Digging up stumps	5	0 0
Clod crushing	1	8 0
Levelling the ground	1	0 0
One maund or 10 seers cotton seed	0	8 0
Sowing seed with drill	2	0 0
Weeding 7 times at Re. 1 each	7	0 0
Hoing or harrowing	2	0 0
Wages for gathering cotton	4	0 0
Carriage to local market	1	0 0

Total Rs. 34 0 0"

Women in seeding the cotton by churka were formerly accustomed to throw into a basket kept for the purpose, large bolls which came to their hands and thus fine cotton bolls were selected for seed. Selection of seed. Owing to the abolition of hand gins, machine ginned, cotton seed is used for sowing purposes and thereby the Jadi variety has deteriorated. Care should be taken to select bolls of good size, free from diseases and then hand ginned and the seed taken for sowing purposes. The cultivators ceased to take the trouble of keeping good seed separate when the prices rose. It is believed that cotton seed should not be placed near chillies which destroy the power of germination. With a view to get rid of the insect pest seed should be steeped in a half per cent. solution of copper sulphate. So that the seed is free from any disease and germinates well. Improvement in cotton is really essential. On the whole (1) plant to plant selection (2) seeds selection are needed at present. The former is more worthy of attention and easier of success than the latter. Seed from good plants will produce good plants but good seed from a bad plant may not give a very satisfactory result.

The importance of seed selection in connection with the cotton industry is being recognised in almost every cotton growing country. The lead in this direction has been taken in the United States, and in Sea-Islands, seed selection and cotton planting have long been regarded as inseparable but the matter has also been taken up in West Indies in Egypt and in Africa and now on a very expensive scale in India. A detailed account of the methods adopted by the growers in the Sea Island for improving their cotton was published in the West Indian Bulletin.

Experience has shown that cotton is influenced by change of environment and the cotton plant varies very considerably by the way in which it responds to the influences of its environments. As a consequence, it is found that the cottons in various West India Islands differ very much in their character, not only that but cotton grown in various parts of the same island differs considerably.

It will readily be understood that there is much chance of producing a very mixed crop. Mixed cotton in the Spinning Factory is disastrous. One of the most important things that the spinner notes in buying cotton is uniformity. Uniformity in colour, length, fineness and silkiness. It is essential, therefore, that every effort should be made to secure this uniformity. At the same time in selecting cotton seed for propagation purposes attention has to be paid to the matter of yield. Some plants will be found to produce four or five times as much seed cotton as others. As it is probable that their character of productiveness will be passed on to offspring; efforts are made to select seed from heavy yielding plants.

The only way to obtain the best results both as regards quality of staple and yield of seed cotton is to practice a rigorous system of seed selection. It has been stated that the cotton plant shows a pronounced tendency to degeneration and this is particularly emphasised in the rapid manner in which the quality of cotton deteriorates as soon as seed selection is discontinued. The cotton grower must therefore realize the necessity of applying a system of seed selection year after year with a view to maintaining and improving the quality of the crop.

Selection was commenced in the field when the bolls were just beginning to open. The healthiest, most vigorous and best stapled plants to be found on seven estates in Barbados were selected. These were free from disease having as few large branches from the bottom of the primary stalk as possible and of medium height (not more than 5 feet and 6 inches). They were plants producing good sized bolls distributed generally over the plant. It was also possible to make in the field a rough examination of the lint. Only those plants which produced long fibre and seed and entirely free from buz were selected. The total number of plants that passed this field Examination was 264. The lint from these plants was picked into separate bags which at the end of the picking season were sent to the Head office of the Imperial

Department of Agriculture in order that the samples could be subjected to further Examination in the laboratory.

Black soil keeps much moisture,—the clay soil requires frequent showers. Red soil requires much rain and if there is any break the lands are liable to become very hard.

Thirty (30) inches of average rainfall is sufficient for Berar. For cotton even a little less suffices but only if it be seasonable and well distributed. Rain ceases in October or in the first fortnight of November and the sky becomes clear. The soil does not dry beyond a few inches from the surface. Underneath it retains moisture till hot weather. On the first fall of rain it absorbs much moisture. The surface is soft and in rainy season it is not possible for carts to run.

There are several kinds of weeds which grow in crops. The list is as under :—

Harali	Patri
Kunda	Sheora
Kush	Kardu
Shiparun	Wasind
Bowcha	Tarota
Kena	etc., etc.

The principal of them which grow in Berar are :—

Seepee grass.—A light, soft, annual grass which grows about the roots of cotton and between the plants. It grows to a foot in height and chokes cotton if not removed in time.

Lona

Do.

Harali.—A perennial grass. It has long roots and spreads rapidly. Its growth is one foot only. If a field is allowed to lie fallow when once infested with it is rendered quite unfit for cultivation unless it be removed by hoe, wakhar or hand.

Runda. This weed cannot be removed by heavy plough but only by digging with pickaxe to the depth of two feet or more. It appears first in small patches in the fields and if the cultivator is careful he eradicates it at once, otherwise it covers the whole field and then it is difficult to eradicate it by the hoe, wakhar, or plough.

The practical suggestions to improve the cultivation are :—

Improvements, (1) choice of soil (2) Preparation of land (3) Tillage *i. e.*, ploughing, harrowing when the plants are in the fields (4) Distance between rows (5) Rotation of crops (6) Weeds (7) Manures (8) Inoculation.

The cultivator knows how to select soil for cotton cultivation. There is no necessity to say more on this point. The subject has already been dealt with under the head "soil for cotton." It is necessary to say something with regard to tillage.

For about 4 to 6 months before sowing, land should be ploughed deeper and deeper and should be kept fallow for a year or so. After one rainfall it should be ploughed a second time with a view to expose it to the air and the sun. Thereby fertility is promoted. Thus the heat kills the roots of the perennial weeds and 3rd ploughing should also be made before sowing. Plants producing pods (*Liguminosæ*) encourage fertility of the soil as their roots have the power of taking nitrogen. Further their roots penetrating deep in the soil gain advantage from the decayed foliage.

The surface soil becomes pulverised and is brought into open porous condition. A harrow or scarifier (light grubber) is used as "Wakhar" every year but it loosens the soil only four inches. Thereby the surface becomes loose. Deep tillage is necessary. So that moisture in the soil when excessive may be evaporated. It also keeps moisture in the soil when it is sufficient for the crops. Shallow cultivation produces shallow rooted plants. There is also another defect in tillage. It is this that when the soil is ploughed, between the two furrows some distance is left when there is resistance while ploughing. So deep ploughing is necessary specially for the cotton soil.

Distance between furrows must be less as no ground should be left unploughed. Proper distance between plants should be left so that free air may improve them. At least 18 inches space should be left between each plant.

The practice of rotation of crops has been already observed by our cultivators but very recently some do not adhere to that practice. Thereby they get less outturn of cotton.

Weeds.—Under this separate head description of weeds has been given. Weeds check the growth of cotton. Weeding operation is therefore an important factor in Agriculture. Cultivators should pay much attention to weeding operation.

Manures.—A separate heading was given for this purpose.

Selection of seed.—To improve the cotton plant, seed should be selected every year immediately after the first picking or even at the first picking. Largest and finest seeds should be selected and preserved. Cotton then grows well.

Inoculation.—By means of liquid manure, the ridges or furrows in the ground may be soiled and thus fertility is encouraged.

Mr. Fletcher has suggested some improvements of cotton in the Bombay Presidency :—

The quality of cotton fibre depends on the following factors :—

- (1) Length.
- (2) Strength.
- (3) Fineness.
- (4) Uniformity.
- (5) Colour.
- (6) Cleanliness.
- (7) Bulkiness.
- (8) Elasticity.
- (9) Yield per acre.
- (10) Price of seed.
- (11) Hardiness of plant
- (12) Method of ripening.

The first four constitute the staple and the 5th and 6th show the gradation. Special attention should be paid to the first and sixth factor for on them depends the value of cotton. Different species of cotton are used for different purposes. Egyptian is used for the manufactures of the fine and strong materials (muslin, laces, &c., &c). American, Broach, Berar

(old) cottons for manufactures of calicoes. Rough cotton of Bengal and Khandesh is used for mixing with finer growth, and also for mixing with wool. An attempt should be made in the direction of a longer, stronger and finer fibre.

The price depends on the process of cotton breeding. Where the inferior cotton grows there the superior one will grow excellently. The picking of the inferior cotton takes 2 weeks while that of the superior will occupy 4 or 5 weeks. Generally the inferior cotton—Khandesh variety comes to maturity in November while the superior Broach ripens in March. The kharif (early crop) cotton gives money earlier than the Rabi (winter) cotton.

Attention must be paid to cotton "Breeding." If the bolls are open they lose in colour, cleanliness and thereby fetch less value. In some cases bolls are surrounded with dried leaves, &c. So at the time of picking much care should be taken.

Experiments on exotic cottons were made in Wardha, Nagpur, Amraoti, Akola Districts, &c. with "New Orleans" from Dharwar by Dr. Forbes but were not successful. The success depends on climate, mode of sowing, selection of seed, way of picking, rainfall, association of other plants, soils, &c.

A rapid development in cotton cultivation has been made but the question of profit and loss accounts for the extension of cultivation of some inferior varieties and the decline of some long stapled varieties within recent years. The lint of Bani is neither as silky nor as long as that of Hinganghat cotton 30 or 40 years ago. The Broach, Surat, and Berar cotton does not keep up the old reputation. But the present conditions of demand are such that special efforts to improve quality are quite in time. The internal demand is for high counts of yarn. Improvements are profitable to Agriculturists.

The application of manure renews the ingredients of which, by constant cultivation the soil has become exhausted or in which it is naturally deficient. The first step towards supplying a suitable fertilizer for our cotton crops should be to see the state

Manures, &c.

of cotton-growing land &c., and to use manures according to the state of the land. For the cultivation of cotton the more the vegetable matter that is returned to the soil, the better. For this reason the cultivator should not lose carbonic manures (*i. e.*, all vegetable matters) within his reach. He should not forget to return to his soil potash, lime, and soda which are absolutely essential for the growth of plants and which are generally exhausted by the constant cultivation of cotton.

Mr. Mercer, the American planter states that "there is no irrigation used for cotton nor manuring except when the Brinjara passing through the tracts of Berar halt at places the soil gets itself manured or when the villagers herd their cattle that piece of land gets manured. But the number of Brinjara has decreased now-a-days and thus the soil does not get manured as before. If manure is used for cotton soil it will yield much more produce but it has to be admitted that it is beyond the power of ordinary cultivators to use manures. They do however manure it as much as their means permit. One acre of land requires 15 cart loads of cowdung. Cultivators save a greater part of the cattle dung for manure in the rainy days and it is heaped up on the surface of the land by which it loses much of its value, it should therefore be closed in pits, sweepings of the house also if added to the dung in pits will serve a good purpose. Generally manure is spread in the hot season on the fields and thus its value is lost.

Silt also from rivers, tanks, &c., is spread in the cattle shed for retaining urine and then it is removed to pits and then to fields.

Penning of flocks of sheep and goats in the fields at night is also practised. The cultivators hire these from shepherds. Penning continues for a fortnight or more. Rs. 10 to Rs. 20 are paid for hiring these sheep and goats.

There are two kinds of manures. One is bulky and the other is artificial. Cowdung belongs to the former and saltpetre to the latter.

Names of manures commonly obtainable are :—

(1) Cowdung, (2) Bones, (3) Oilseed refuse, (4) Nitre, (5) Saltpetre, (6) Silt, (7) Urine, (8) Penning of sheep and goats, (9) Ashes, (10) Dry leaves, barks, &c., of trees, (11) Green manure (leguminosæ pods), (12) Rotation of crops, (13) Night soil.

The economic value of the superior varieties of cotton from the Commercial point of view is very great. As these varieties are greatly esteemed and often command a higher market price than the indigenous varieties, it is worth while to replace the latter with more improved and better exotic varieties. Experiments are already started with this object in view and the results are pretty decisive. The introduction of exotic varieties looking to the change of climate and other conditions is always a most difficult problem and hence such attempts have been abandoned in many places. Those who have practical experience of Farm cultivation will assert that the only way of achieving success is to improve the existing types by some means or other and not to introduce foreign ones. On this Mr. H. S. Lawrence, I. C. S., Director of Agriculture in the Bombay Presidency read a paper which was published in the *Bombay Gazette*, dated 6th February 1908. An extract from that paper has been re-produced here for reference with his opinion on the Indian cotton problem. It is as follows :—

* * * * *

In reviewing the economic progress of Agriculture in India Mr. Lawrence urged that the cotton problem was not so easy of solution as enthusiasts at home are inclined to imagine and the Government of India is not open to the re-proach, sometimes levelled at them, of indifference to the cotton interest. A long course of disappointing features led to the adoption of a sound policy of economic progress. It was, he said at length realised that the first need of the country was the facility of transport and the precision of organised agricultural enquiry based on the co-operation of the people. In the first half of the last century,

there was no co-ordination in the experiments made in different regions, it is true that success was attained with such products as tea, indigo and coffee, which offered favourable field for European enterprise in suitable climatic conditions, but Government possessed no skilled agricultural advisers to investigate and advance the cultivation of the staple crops. Sometimes, as in the case of cotton, the measures adopted, met with much active opposition from the people, who saw no advantage in growing the superior quality of lint. The cotton exports of those days were barely 5 per cent. of the total produce and the inferior fibre not only was suitable for the internal consumption of India but commanded an equal price and was secure in outturn.

The railway extension, metalled roads, unmetalled roads, irrigation works and their upkeep, &c., represent $\frac{1}{4}$ th of the whole public debt of the country. The policy thus steadily pursued has transformed the agricultural economy of whole Province.

In 1854 the court of Directors stated the opinion that there was "no single advantage that could be afforded to the vast population of India that would equal the introduction of an improved system of agriculture." In 1870 the Government of Lord Mayo established a Department of Revenue and Agriculture in the belief that Indian agriculture was susceptible of almost indefinite improvement." Financial pressure led to the abolition of the Department after nine years of existence but was re-established by Lord Ripon in 1886 with the object of "maintaining agricultural operations at the highest attainable standard of efficiency" and much attention was paid by Lord Curzon in 1902 and that a body of scientific workers was supplied to the Department and the staff has been recruited from European Scientists for education of the people of India in agricultural matters.

AGRICULTURE : A RETROSPECT.

BY V. V. JOGIAH ESQ.,
First Grade Pleader, Berhampore.

India is pre-eminently an agricultural country. 80 per cent of its population are dependent on Agriculture. So that the agricultural problem is a most vital one and deserves the earnest and serious attention of both the rulers and the ruled. There is no denying that in spite of its importance, our methods of agriculture continue to be primitive. Our knowledge of agricultural science, practical and theoretical, has, instead of improving, of late years, deteriorated, though we find there is an ardent desire just at present to acquire knowledge and improve the agricultural condition of the country. It must be admitted that the surface soil of the lands in the country being subjected year after year to the methods of cultivation in vogue from time immemorial has become exhausted and we have not taken care to relieve the lands for a number of years by adopting the system of rotation of crops or using powerful manures which science suggests and which other countries have adopted with advantage. It is therefore the paramount duty of both the Government and the people to take stock of the present agricultural methods of the country and strive to raise the ryot from the quag-mire of poverty in which he finds himself immersed to-day. It is a matter for gratification to note that both the Government and the people have become alive to the importance of the situation and a beginning has been made to carry on agricultural reforms on some systematic lines. Practical steps, though by no means sufficient for the needs of the country, are being taken for the encouragement and improvement of agriculture. This spirit on the part of the Government and an anxious desire on the part of the people to improve the largest and perhaps the sole

surviving industry augur well for the future. The Government have taken in hand agricultural research, the training of students and the scientific and experimental farming. It has founded a few Schools and Colleges ; established a number of farms ; started a few experimental pumping stations and Veterinary Hospitals, arranged cattle shows, awarded prizes to encourage the breed of cattle ; issued bulletins and pamphlets for the benefit of the agricultural population ; directed experiments to be made for the reclamation of saline soils. While the Government has begun its work in the direction of agricultural improvement in earnest, the non-official public are not behind hand in doing their best in the matter. They started Agricultural Associations in each District. They have been running shows almost in every district. They have been discussing problems agricultural, in their annual conferences. But recognising as we do this re-awakening in this country and appreciating with gratitude the interest evinced by the Government, we cannot help remarking that we lamentably lack efficient Agricultural Schools or Colleges ; the experimental farms and pumping stations can be counted on one's fingers ; the staff of agricultural experts is exceedingly small ; the bulletins issued are very few and serve as yet no useful purpose ; and in fact the allotment of 20 lakhs a year made by the Imperial Government some years ago for agriculture is too small, and the Agricultural Associations have not been able to do the work which was expected of them and to attract the notice or gain the good will of the agricultural population.

AGRICULTURAL PROGRESS IN THE UNITED STATES.

While on this subject it would be not out of place here to refer to the progress which agriculture has made in the United States of America—a country where the Government and the people have to attend not merely to agricul-

ture but have to bestow their attention on many other industries. One will be struck at the amount of useful work which it has been doing in this direction. I had occasion to speak of this subject often but I am sure the importance thereof bears any amount of repetition. We were told by the Honourable Mr. Hamilton in the year 1904 from his seat in the Imperial Legislative Council that the annual income of the land grant Colleges and other Agricultural Institutions of America is 6½ million dollars or nearly Rs. 21 millions. There are 54 Agricultural experimental stations maintained by the State. A sum of 720,000 dollars or Rs. 22 millions are spent annually on this account. From the provincial funds a grant of 9 lakhs of Rupees is made. There are 10 Agricultural Colleges. The staff employed in these Institutions number 685 of whom 308 are teachers scientifically trained. The number of publications issued by the American Board of Agriculture annually is nearly 6 millions, not to speak of innumerable bulletins issued every now and then by the Government. Such is the wonderful work which, we were told, it had been doing and the results did not belie its expectations. As to the utility of improved methods of Agriculture and scientific farming if we take America and Siberia and compare their present condition with what they were a few years ago, we will find what gigantic improvements modern science has effected in the agricultural condition of the two countries. We all know what Siberia was a few years ago. It was no better than an arid and deserted waste. We are told it is now almost a garden. This is due to the application of modern science to the improved methods of agriculture.

NEED FOR INVESTIGATION INTO LOCAL AGRICULTURAL PRACTICES,

When I refer to this I do not mean that the Government or the people should introduce these reforms all at

once or that it is absolutely necessary to borrow all the methods employed in advanced agricultural countries like America, Japan, Belgium or Holland, whatever may be the progress which these countries have made in matters agricultural. I am one of those who advocate a study of local agricultural practices before we think of effecting scientific improvements and adopting those found in foreign countries into our agricultural methods. Eminent Scientists like Dr. Voelckar have recorded it as their firm conviction that Indian agriculture is good and the Indian ryot has not much to learn from his Western brethren. The same eminent authority considers that the cultivation in Nadiad and some other parts of Guzerat is about the best in the world. Sir Frederick Nicholson who was so popular as an official and whose love for this country has induced him to make it his home referred to the garden cultivation of Coimbatore in eulogistic terms. In the matter of agricultural implements and manures also the systems obtaining in the West to some extent are either unnecessary or unsuited to the conditions of our country. For instance, steam ploughs, mowing machines, costly threshing and husking and hulling machines, etc., such as are used in America and other Western countries are needless and will be disproportionately expensive for this country where labour is cheap and ready to hand and skilled mechanics to repair are rare. But improved Swedish ploughs like those now in use in the Ceded Districts of the Madras Presidency will be of great service. Again in the matter of manures, though powerful manures are available in the West, their cost is prohibitive and they are not absolutely needed as there are valuable manures in the Country to replace them. So that the view of Mr. Robertson, who is no doubt considered to be the pioneer of agricultural education in this country, that the Indian agri-

culturist knows nothing of his business and his methods or practices are utterly wrong, wasteful and unscientific, is not quite correct. It is therefore necessary that a commission of a few experts must go about the country, study and collect information as to the existing methods of cultivation, implements used and manures employed and put the best of these methods and practices into operation and introduce them in backward Districts by modifying and adopting them to the existing conditions of the place where they are to be introduced ; other practices and methods which do not obtain here but which will be equally useful in this country may be borrowed from abroad, provided the cost is not prohibitive. This method, if employed, will be both popular and cheap.

NEED FOR AGRICULTURAL CO-OPERATIVE ORGANISATIONS.

● In this connection it is necessary to bear in mind that our country is a country of small holdings and high interest and the cultivator has little or no capital but has ample skill unlike his brother of the west who has comparatively large capital but little skill. The advantage which his western brother possesses over him is that he can use the information as to the new methods of cultivation at his disposal at once, as he commands the necessary capital. The capital employed on agriculture has doubled since 1840 in Europe and increased six-fold in the United States, while the Capital employed in this country has been extremely low and shows no signs of increase. What little increase there is in production is due to the employment of a larger number of hands and to the bringing under plough larger areas but not to the introduction of the improved implements or new methods which developed agriculture in all the civilized countries of the world. So that if we want to improve the lot of our cultivator, we must bring within his reach capital, the supply thereof being

made promptly and on terms which the cultivators can accept. To some extent this supply is being attempted by the "Grain Banks" in Bengal and the Co-operative Rural organisations lately formed throughout the country. But at present they are few in number and must increase until we find one in each big village. If we are to prevent the present progressive degradation of this great industry it becomes our paramount duty to betake ourselves to villages, explain to the villagers the benefits of co-operation, encourage the expansion of co-operative organizations and enable them not to borrow at usurious rates.

IRRIGATIONAL FACILITIES AND LIFT IRRIGATION.

Further, no fund of scientific knowledge and no amount of improved methods of cultivation would avail us unless we are provided with good irrigational facilities. Some parts of the country are more fortunate than others in this respect on account of the large rivers they possess. While guarding myself against minimising the utility of large irrigation projects, I must not omit to urge upon the attention of the authorities and the public the necessity of reviving large storage tanks in our villages. Connected with this subject, is the pump irrigation which has been largely developed in the Presidency of Madras to which my experience is confined, through the exertions of the Department of Industries under the able guidance of its energetic Directors, Mr. Chatterton and his staff, who have discovered new sources of underground supply of water by boring operations. Though the first experiment in respect to this pump or lift-irrigation was made 20 years ago yet a steady increase in pumping operations has begun only since 1902-3; and within these eight short years considerable interest has been created for this kind of irrigation in the ryots of the Madras Presidency and much progress has been made. We are told that so far as Madras is concerned "there are now 250 pumping in-

"stallations—13 owned by Government; 178 erected by
 "private persons with the aid given by Government ; and
 "the rest exclusively by private persons. These engines
 "and pumps lift water from wells, channels, tanks and ri-
 "vers and irrigate at a rough estimate 12,000 acres. The
 "total capacity is reckoned at 9.25 gallons per hour or
 "4.11 cubic feet per second. The capital invested in these
 "250 installations is stated to be nearly 7 lakhs of rupees
 "and the cost of cultivation in area irrigated by these en-
 "gines is calculated at Rs. 30 per acre." Judging from the
 results already achieved in Madras and the work already
 done, great hopes are entertained about the future of this
 irrigation. It is a matter to be deplored that in spite of
 the recommendations of the Madras Government, the
 Secretary of State for India in Council decided to abo-
 lish the post of the Director of Industries and place
 these pumping operations in the charge of the agricul-
 tural department. To place operations of this sort, which
 require a knowledge of engineering in those who presume
 to give advice to ryots under the agricultural department,
 is, I consider, a retrograde step and this will place ryots at
 the mercy of the Firms that import, supply and repair the
 machinery, and, I fear on the whole the operations so
 successful at present will be discouraged and the cost of
 boring wells and lifting water will increase. I hope the
 Secretary of State will reconsider his decision as the ex-
 tension of irrigation through lifts is still in its infancy
 and requires careful nursing and cheap execution under
 expert guidance.

DIGNITY OF LABOUR.

" If we are really to improve the agriculture of our
 country there is one aspect which should not be lightly
 passed over. Our educated young men must learn not to de-
 spise the calling of a peasant. They must not consider agri-
 culture to be a degrading profession. Though once our

Aryan forefathers were all agriculturists, we have now come to despise the position of our ancestors and unless we begin to respect their calling, we cannot hope to improve our country and rise in the scale of nations. It is a matter of common knowledge that a cultivator, however rich he may be, however good and straightforward his conduct may be, is not respected. He is at present looked down upon even by the pettiest of officials. This is one of the reasons why our young men have no attractions for this profession. If some men of intelligence, men who have taken their degrees and studied Physical Science, Chemistry, Geology or Botany, can be induced to undergo a course of training in Agricultural Colleges, *then and then alone*, we can hope really to apply the principles of modern science to the methods of improved agriculture. We, therefore, earnestly hope that some of our young men will attach importance to dignity of labour and will, instead of getting into the beaten tracks of public service or the bar, help themselves and the country by taking to agriculture, which, if properly worked, can never prove unprofitable.

EXCESSIVE ASSESSMENTS.

In spite of the already inordinate length of space I have allowed in this paper of mine to agriculture, I cannot help, on account of its highest importance to the ryot, making at least a passing reference to the excessive and periodical, or I should say short-term, assessments, which tell very highly upon the chronic impecunious condition of the ryot. The subject has been discussed often and I do not therefore wish to dilate upon it but simply state how erroneous it is to say that our assessments are moderate. A comparison of our assessments with those in Europe shows how high our assessments are. In Europe it is estimated that the proportion of rent to gross produce is 1 to 55, while in India it is 1 to 3 or 4. This shows how excessive, comparatively, are our assessments. It is therefore abso-

lutely necessary, if the ryot is to be saved, that some sort of permanent settlement should be granted to him and the period of revision should be increased at least to 60 years.

REQUISITES.

What we, therefore, ask our Government and the landed aristocracy to do is to give our ryots a sound elementary education, to disseminate broad-cast a knowledge of agricultural science and improve methods of cultivation. We want them to found scholarships for our young men. We want in every District, in the Head Quarters of the Collector, a branch of the agricultural department under the directions of Agricultural Superintendents with a number of Inspectors under them. We want model farms on an extensive scale to be opened in the Head Quarters of each Taluq with an Agricultural Museum attached thereto, which is accessible to the agricultural population. We want tables containing an analysis of soils of each Taluq, so far as practicable, to be prepared and kept in these Museums, so that those ingredients of the manures which are wanting in them may be supplied. We want the Inspectors under the supervision of Superintendents to establish small model farms in rural centres, make experiments, distribute leaflets to the ryots in vernaculars, and lecture, in easy language which they can understand, the advantages of improved methods and demonstrate to them the benefits thereof at their very doors. We want the irrigational facilities to be greatly increased, the permanent settlement to be considerably modified, and the terms of periodical settlements increased. In fact, we want the Government and the landed aristocracy to expand the Agricultural Department and to bring home to the doors of our people in the villages, all the help which modern science has been able to find for the improvement of agriculture. These are some of our wants and we hope the Government and the landed aristocracy

with the help of our District Agricultural Associations will give them their early and undivided attention.

SUGARCANE AND SUGAR INDUSTRY IN INDIA AND OTHER COUNTRIES.

BY R. S. HIREMATH, ESQ.,

L. Ag. Poona.

The Sugar industry throughout the world has reached a stage in the history of its development that has resulted in most important changes in the sources of supply as well as in the methods of manufacture. For centuries cane has supplied the human race with sugar; the cultivation of which and the manufacture of its product has formed one of the most important of the world's industries, as well as one of the most extensive branches of the world's commerce. It had no rival or competitor in supplying this necessary food staple until the ingenuity and enterprise discovered, utilised and developed the saccharine properties of the beet root. Gradually a new industry sprang into existence and has steadily progressed until to-day it challenges the supremacy of the cane product.

This contest had, on the whole a beneficial effect in stimulating most cane growing countries to better methods of cultivation and manufacture. But India has made little or no progress in this direction. Though it is regarded as the original home of sugarcane and the greatest sugar producing land in the world, still it would seem that it is losing rather than gaining ground day-by-day. Its present importance in the world's market is rather insignificant, since the exports have fallen off from 72,000 tons per annum in 1889-1890 to 11,000 tons in 1903 and still less at present. Imports of sugar are exceeding very largely the earlier records. Sugar represented 52.07 per cent. in 1906-07 and 55.8 per cent. in 1908-09 of the total

value of articles of food and drink imported into India and it not only maintains but continuously strengthens its position as the second largest single article of importation. The following table clearly illustrates the arrivals of cane and beet sugar in India in each of the last eight years. This excludes molasses and confectionery.

Year.	Cane sugar in Cwts.	Beet sugar in Cwts.	Total of both in Cwts.	Total value in Rupees.
1902-03	3,529,678	1,467,517	4,987,195	4,76,98,248
1903-04	5,485,378	552,737	6,038,115	5,77,23,418
1904-05	4,833,309	1,716,488	6,549,797	6,71,08,487
1905-06	4,262,929	3,433,262	7,696,191	7,50,02,109
1906-07	5,926,848	3,803,834	9,730,682	8,18,29,277
1907-08	9,250,841	794,060	10,044,901	8,79,19,287
1908-09	8,719,259	1,944,024	10,663,283	10,40,97,056
1909-10	10,276,878	859,206	11,136,084	10,97,82,740

This clearly shows the deficiency of production of sugar in India.

Though the sugars of Java, Mauritius, etc., bear the heavy burden of ocean freight from 12 to 15 shillings per ton and the imperial duty of 5 per cent, it is strange to find that they are holding their own in one of the greatest cane-growing countries like India. In order to find out the defects that lie at the bottom of this we cannot do better than study the conditions of other cane-growing countries from every possible direction. Though the statistics of cane and sugar production of any one place cannot be taken as affording an index to the capabilities of any other place on account of varying conditions necessarily existing, much information of a comparative nature may still be gained by placing such details in a collective form. They will be useful for reference in drawing conclusions as to the results of new processes and their superiority or otherwise to older plans. With this intention in view, I place below some of the available information about those countries before proceeding to India,

(a) Denotes figures not available. The figures taken about the yield of cane and sugar and sugar in cane are average ones.

No.	Sugarcane localities.	Average yield of cane per acre in tons	Average yield of sugar per acre in tons.	Tons of cane required to produce a ton of sugar.	Sugar in one hundred parts of cane.	Total sugar recovered on one hundred parts of cane.	Sugar lost in Scum, Molasses, etc., on one hundred parts of cane.	Number of factories working.	Total amount of sugar produced per year in tons.	Remarks.
1	Cuba (West Indies.)	19.5	2	9.75	14	10.25	3.75	186 of which 175 are centrals.	{ 960,000 to 1,800,000	General information about the place as regards cultivation, manufacture, or any other particular of special importance is given below.
2	Java ...	36	3.6	10	13	10	3	181	{ 1,055,000 to 1,390,000	
3	Hawaii ...	38	4.94	7.69	16	13	8	47	{ 593,000 to 480,000	
4	Mauritius ...	40	4.4	9.09	15	11	4	65	{ 170,000 to 240,000	
5	Peru (South America.)	40	4.5	8.33	15	11.25	3.75	65	{ 140,000 to 160,000	
6	Barbados (West Indies.)	80	2.2	13.6	13.5	7.33	6.17	(a)	{ 30,000 to 50,000	
	Do.		3.1	Old Machinery. 9.67 (New Machinery.)	Do.	10.33	(Old Machinery.) 3.17 (New Machinery.)			

7	Louisiana (United States)	20	1.77	11.29	12	8.85	3.15	200	{ 800,000 to 835,000
8	Porto-Rico (West Indies)	25	2.5	10	13.5	10	3.5	48	{ 190,000 to 800,000
9	Demerara (British Guiana.)	2.0	1.5 (old method)	13.38	12	7.5 (Old method.)	4.5	45	{ 100,000 to 118,000
		Do.	1.8 (New method)	11.11	Do.	9 (New method).	8		
10	Argentina (South America).	12	1	12	12	8.88	3.67	28 (at Tuenman only).	{ 109,000 to 164,000
11	Antigua (Leeward Islands).	12.61	0.98 (Old Method)	13.55	13.5	7.87 (Old method).	6.13	(a)	About 18,000
		Do.	1.81 (New Method).	9.62	Do.	10.38 (In central factory).	3.12		
12	Trinidad (West Indies)	20	1.8	11.11	13	9	4	(a)	{ 87,000 to 51,000
13	Formosa (Japan).	25	3.75	9.09	14.5	11	13.5	50 of which 15 are cent- rals.	{ 82,000 to 160,000
14	Queens and (Northern Australia).	16	1.6	10	13.5	10	3.5	(a)	{ 182,000 to 184,000
15	Mexico ...	30	3	10	13.5	10	3.5	(a)	{ 115,000 to 150,000

General information about the place as regards cultivation, manufacture, or any other particular of special importance is given below.

No.	Sugarcane localities.	Average yield of cane per acre in tons.	Average yield of sugar per acre in tons.	Tons of cane required to produce a ton of sugar.	Sugar in one hundred parts of cane.	Total sugar recovered on one hundred parts of cane.	Sugar lost in Scum, Megasee, Molasses, etc., on one hundred parts of cane.	Number of factories working.	Total amount of sugar produced per year in tons.	Remarks.
16	Egypt ...	22	2.2	10	13.5	10	3.5	More than 10	{ 48,000 to 60,000 About 70,000 About 186,000 2,500,000 to 3,000,000	General information about the place as regards cultivation, manufacture, or any other particular of special importance is given below.
17	Natal ...	28	2.8	10	13.5	10	3.5	More than 40		
18	Spain ...	20	2	10	13.5	10	3.5	(a)		
19	India ...	25 (Good average).	1.25	20	13	5	.8	45		
20	Manjri (Govt. Farm Bombay).	35.71. (Pundia Variety)	{ 4 (gul) or 4.85 (Rab) or 3.007 1st and 2nd sugar by centrifugal	8.92 per ton of gul	16	11.20 (In the form of gul).	4.80 (In Mali Megasse, etc).	...		
				11.87 per ton of sugar.	Do.	8.42 (By preparing Rab and working in centrifugal).	7.58 (In Mali, Megasse, Molasses, etc).	...		
21	{ In U. P and Bengal factories.	14 to 17	13	5.88 to 7.14	5.86 to 7.12	32	...	
22	Hadi's method.	17.06	13	5.86	7.4	
23	South Arcot (Lowest yield in factory).	30	2	15	13	6.66	6.34	2	...	

1. CUBA.

A. Agriculture :—

Sugarcane was introduced here in 1523 by the first Lieutenant Governor.

The climate is unsurpassed for the growth of cane. Heavy tropical rains are frequent from June to December and frosts are unknown.

The general fertility of the soil is very great. The principal cane belt is the level strip of country extending almost round the island near the coast. The red sugar lands are derived from highly ferruginous lime stone, and constitute the best sugar lands in Cuba. Though this soil is very sticky and heavy when wet, it is extremely pervious to water and drains well. The black sugar land occurs largely in the hilly parts with white calcareous sub-soil, and in the level districts, it is underlaid by a yellow or brown clay sub-soil. The black land is heavier and more tenacious than the red. About 2,000,000 acres are under cane cultivation.

Few fields are thoroughly cleaned, ploughed and prepared for the crop and no irrigation works exist. Little manuring is done. Improvements in the mode of culture and the use of fertilizers are newly attracting the attention of the cultivating public.

The cane is produced by cuttings and takes about 18 months to mature. Usually the cane is planted in hillocks 3 ft. apart in rows 5 ft. apart. Of late, the system in which the hillocks are planted 9 ft. by 12 ft. apart has been strongly advocated as affording means of cultivating by machines drawn by animals and yielding a greater number of successive crops and richer cane, although giving less yield the first year. If roots are not damaged in harvesting, the yield will continue from 5 to 25 years, gradually diminishing in amount, though the juice in

creases in density and purity as the plants grow older in years. Ten successive crops can commonly be harvested from one planting. Then the land is left fallow for some years for pasture purposes.

The grinding season lasts from December to June. The cane is cut by hand with broad-bladed cutlasses, stripped of all leaves and tops, cut into pieces about 3 ft. long, and then carried to mill either by ox-carts or by rail cars.

The principal varieties of cane grown are the Crystallina, Blanca, and a red or purple stripped cane. These contain from 10 to 12 per cent. fibre and sugar from 13 per cent. in December to 18 per cent. in March and April. The crops yield from 12 to 60 tons of cane per acre. The average yield is probably 15 to 20 tons. The increased yield is often due to extra age. One man claims to be cutting cane nearly two years old which is giving him the equivalent of 4 tons of sugar to an acre, when last year it would have yielded a little over two tons. Cuban cane does not suffer much from the ravages of disease and the attacks of insects as in other countries. The cane has very tough silicious rind with abundant internal juice.

B. Manufacture :—

Factories obtain their supply of cane in part or altogether from farmers who raise it on their own land or land belonging to the factory. The manufacture of sugar has been benefitted by the use of steam power and the introduction of well equipped factories with the newest machinery and working under scientific management. Formerly the juice extraction was from 62 % to 65 % but since the introduction of triple mills (nine-roller mills) and crushers in conjunction with imbibation of water or steam the juice expression has come to be 75 per cent to 80 per cent of the cane, and the sugar extraction

from 90 per cent to 95 per cent of the sugar in cané. In some cases nine-roller mill has been superseded by twelve-roller mill with satisfactory results. Various crushing devices, which are indispensable when working certain cane varieties have been added to the milling plants. The amount of water of maceration added at the mills varies from 3 per cent to 8 per cent of the weight of cane, being limited by the expense of its subsequent evaporation. This leaves in the Bagasse about 7 per cent to 9 per cent of sucrose, equal to from 2 per cent to $2\frac{1}{2}$ per cent of sugar on the weight of cane. In the manufacture of raw sugar 4.60 parts of sugar (2.79 parts in megasse, 1.23 parts in molasses, 0.10 part in scum 0.48 part unknowingly) out of 14.85 parts of sugar in 100 of cane was formerly lost. Now the losses have been reduced to a considerable extent by the introduction of the improved machinery. Sugar can be produced here at the cost of two cents (less than an anna) per pound.

Associations have been organised for the encouragement and protection of cane growers.

2. JAVA.

A. *Agriculture* :—

In 1830, the Governor-General introduced his famous culture system under which the natives were compelled to cultivate cane on part of their land, and Government contracted with Chinese and European manufacturers for the erection of sugar factories and the manufacture of sugar from the cane grown under its control. The cultivation of cane was introduced in this manner in a very short time. In 1861 the cultivation increased so much that Government was obliged to decree that only one-fifth of the land in the hands of the natives should be used for

the production of sugar, so as not to dispossess the natives of the lands needed for the cultivation of food-stuffs. The area has increased from 260,810 acres in 1906 to about 300,000 acres in 1909. Planters have been enabled by the improved methods of cultivation and the experience of fertilizers best suited for various soils to make use of the land that was formerly considered unfit for cane.

The year is divided into two seasons by the prevailing winds : (1) the rainy season that of the west Monsoon lasting from November to March and (2) the dry season that of the east Monsoon during the rest of the year. June and July are usually dry months. There are no long periods of continuous drought. The east Monsoon blows steadily for a longer period than the rest. The rainfall varies from 40" to 90" annually. Rivers distributed throughout the whole of Java serve the purpose of irrigating sugarcane areas.

August is the chief planting month. Only one crop is taken, the canes being cut as a rule 12 months after planting. The yield of cane per acre has been raised to 40 tons, 92 tons per acre being the maximum. The yield of sugar per acre has increased from 2.5 tons in 1887 to 4.5 tons in 1909. The chief factors, which under propitious weather conditions help to bring about satisfactory results here, are the continuation of scientific and systematic cultivation, the careful selection of cane, and the rational and frequent application of fertilizers coupled with the closest attention to the prevention of cane disease.

Experiments in the cross fertilization of sugarcane have met with great success. Much attention has been paid to the raising of canes having a higher sucrose content both by chemical selection and by the propagation of the highly promising seedling cane varieties. Though the sucrose content has practically remained the same, the

tonnage per acre has considerably increased. Some investigators selected canes of varieties which promised much in one direction or other and cross-fertilised their flowers, so that the fertilization was effected with carefully selected pollen of specially chosen fathers. The results were brilliant and families of sugar cane which surpass in every point the canes of yore came into existence. Now, there is such a variety of good and rich cane that every estate owner can choose the variety which best suits the quality of his land, or his climate, and even suit the time he wants to harvest them. He can choose early ripening varieties for the beginning of his crop, and the late ripening ones for the end, and so dispose during the whole course of his grinding time green, fresh, and sound cane at its highest point of sugar content and vigour.

The excellent Java returns for the last few years are partly due to the introduction of the seedling canes. Many thousand acres are now covered with the descendants of seedlings No. 247, No. 100, No. 36, No. 139, No. 213, No. 228, etc. The first two are prominent. No. 100 is one of the best cultivated in Java, rich in sugar, poor in fibre, but rather delicate in regard to the quality of the soil. Mr. J. D. Kobus says "In 1897 we chose as a limit of selection a calculated production of 4 tons of available sugar per acre, since that year the sugar production has so much increased, chiefly from the introduction of the older seedling varieties and a more rational culture, that we raised our limit to nearly 7 tons per acre". After various experiments he has arrived at the following results :—

1. The heaviest plants are the richest in sugar.
2. The progeny of rich plants are heavier and richer in sugar and that therefore a selection based on the sugar content is quite rational,

3. Plants grown from cuttings derived from canes rich in sugar are heavier and contain more sugar than those grown from average plants or from plants poor in sugar.

4. When we select the richest canes from the descendants of canes that were already rich in sugar and also the poorest canes from the descendants of poor canes, and go on in this way for some years, we very soon arrive at a considerable improvement of the rich canes (40 per cent in 5 years) and a heavy depression in the descendants of the poor ones (16 per cent in 5 years).

5. The descendants grown from cuttings of once selected canes remain richer in sugar for at least four generations.

6. The correlation of a high sugar percentage in the juice and heavy weight of cane plant simplifies the method of selection in a remarkable way.

B. Manufacture :—

Sugar is manufactured according to the most scientific and up-to-date principles in properly equipped factories. The methods of manufacture are extremely perfect and economical. Crushing takes place from May to November. Nine roller and twelve roller mills with various crushing devices are used. Begasse is macerated before passing through the second and third mill with 12 per cent. to 15 per cent. water. This gives diluted juice equal to 81 per cent. to 83 per cent. of the undiluted juice and 90·8 per cent. to 93 per cent. of the total sugar from the cane containing 88 per cent. to 90 per cent. of the juice and 10 per cent. to 12 per cent. of woody fibre. Looking to the factory average results of ten years on a number of Java estates, 1·11 to 1·36 in Begasse, 0·09 to 0·10 in filter press mud, 1·05 to 1·26 in molasses etc. and total 2·25 to 2·72 of suc-

rose on 100 of cane is lost. Every year the sugar content in the Begasse is being diminished. Formerly there was 5.5 per cent. to 6.5 per cent. of sugar in Begasse but in 1908 it reached about 4 per cent., *i. e.*, 0.80 to 0.90 per cent. on cane. Care is being taken about other losses. The cost of producing sugar is about 9 shillings per cwt. free on board, *i. e.*, a little less than an anna per pound.

By-products.—A sugar manufacturer in Java has succeeded in producing a good fertilizer, known as "Molascinder," from a mixture of waste molasses, ashes from the furnaces, filter press mud, and well-dried pen manure. This contains 0.42 per cent. of N. 0.98 per cent. of P. 205 and 1.2 per cent. of K. O.

From filter press mud cane wax is also extracted. The wax passes over into the juice on grinding, and afterwards becomes precipitated in the scums on clarification. It may amount to 10 per cent. in dry scums. It may be mixed with paraffin for the manufacture of candles.

There are Associations for the encouragement of cane growers, and a system of "Mutual control" in factories by which the results of each individual factory are collaborated and compared.

3. HAWAII.

A. Agriculture :—

Hawaiian Islands lie within the tropics. All the Islands are extremely mountainous. The soil is rich and of great depth. 100,000 acres are under cane cultivation. Rain-fall varies within wide limits from 30 to 200 inches. A splendid supply of water underlies the Islands. They do not depend entirely on rain-fall for irrigation. Very costly irrigation systems have been installed. The steam plough works everywhere.

Plant canes take 18 to 24 months to ripen, after

which one, two or occasionally three ratoons are taken. If the ratoon field is not deemed capable of giving 30 tons of canes (equal to 3 or 4 tons of sugar) per acre, it is torn up and plant cane set out. Hilling up of ratoon cane is considered as the best system of ratoon cultivation. Irrigation and use of fertilizers are resorted to extensively and to a very great advantage. Nitrogen is best applied as NaNO_3 in small doses, preferably mixed with irrigation water 100 lbs. to 150 lbs. being the usual amount per acre. The most profitable application of water is two to three inches per week. One hundred grains of common salt per gallon of irrigation water is adopted as the "Danger point" for sugar cane. £ 8 per acre are spent for artificial manures.

The rate of wages is three shillings per day. The scarcity of labour has brought forth the "share system" of cane cultivation. This system consists of the division of the land to be cultivated into blocks. The land is prepared and planted by the estate and the blocks (each of 60 acres) are then handed over to cane companies, which may be composed of either free or indentured labourers or both, and which carry on the cultivation under the supervision of the estate management. Until the cane is harvested the members of the cane company receive an advance of one shilling per day for each day of nine hours worked by such members, such payments being afterwards deducted from the price paid for the cane. When the canes are cut and taken to the mill, the cane company is credited with the amount per ton agreed upon beforehand, and from this are deducted the advances made during cultivation, and the cost of any work done by the estate after handing over.

The two chief varieties of cane now grown in Hawaii are the Lahanja and the yellow-Coledonia. Smaller

quantities of Rose-Bamboo, D. 117, and the Tip canes are also present. Yellow-Caledonia is inferior to Lahania or to Rose-Bamboo. Lahania contains from 10 to 12 per cent., Rose-Bamboo from 12 to 13 per cent. and yellow-Caledonia from 13 to 14 per cent. of fibre. Lahania is grown under irrigation and the yellow-Caledonia under natural rain-fall. The sugar in cane varies from 16 to 18 per cent. Lahania variety yielded in 1907, 75.48 tons of cane and 12.94 tons of sugar per acre with ordinary manures, but 100.78 tons of cane and 15.92 tons of sugar per acre with fertilizers. Five to seven tons of sugar per acre is the average yield of Lahania variety and two to four tons per acre of other varieties.

The predaceous beetles feeding on the larvæ of cane borers, discovered by Mr. Muir in the Malay Archipelago, have been distributed at Honolulu in cane fields where borer was abundant. The result is not yet known.

B. Manufacture :—

In 1850 the mills in use were only the old Asiatic ones with rolls of wood and stone, and the yield of sugar was scarcely one ton per acre. The great development of the sugar industry followed with the investment of many millions of American and English money in large plantations. The cane is worked up in factories of the most up-to-date construction under scientific management. The types of mills now in use vary from nine-roller mill and crusher to fifteen-roller mill, crusher and revolving knives. 80 per cent. to 85 per cent. of the juice in cane is expressed. Taking a dilution of about 25 per cent., on a nine-roller mill and crusher the extraction will be about 93.50 per cent., on a twelve-roller mill and crusher about 94.50 per cent., and on a fifteen-roller mill, crusher, and revolving knives about 95.25 per cent., of the

sugar in cane. Where 20 per cent., 30 per cent. or even 40 per cent. of water of maceration is added in two or three instalments, the extraction of sugar is much more thorough, only 4.5 per cent. of sugar being left in the Begasse, equal to 1 per cent. on the weight of cane. The direct losses in the manufacture, comprising the losses in scum, molasses, etc. average 7 per cent. equal to 1.55 per cent. on the weight of cane.

The cost of producing one cwt. of sugar is 8s.6d. in the factory not counting the expenditure of sending to ports. This comes to a little less than 11 pies per pound.

The modern 80 ton plant consisting of multi-tubular boiler, 9-roller mill, crusher, carrier, conveyor, clarification appliances, vacuum pans, mixer, centrifugals, etc. has cost \$400,000 or £ 290,370-7-5.

By-products.—Scum press cake is very generally used as a fertilizer and with good results. Molasses is used as fuel, as stock feed and as fertilizer.

As at Cuba and Java there are Associations for the protection of cane growers. As at Java, there is also a system of "mutual control" among the factories.

4. MAURITIUS.

A. Agriculture :—

The climate is an excellent one for cane growing. The average temperature throughout the year is 75° F. The rainfall varies from 60" to 120" from December to March, the average being 75". The great drawback to the Island is the frequency of cyclones during the rainy season.

The soil varies considerably, deep in some places and shallow in some. It is light porous loam frequently so strong as to render ploughed furrows impracticable.

Tops are used for planting. They are first carefully

examined, washed in lime water and then planted in holes about 9" or 10" deep, about 3,000 to an acre. Weeding and thrashing are the only things necessary, except that heavy manuring is needed to secure fair crop owing to intense cultivation in past years. Artificial and pen manures are extensively used. All the sewage and refuse from villages is sent to the manure works of the estates, and used in the fields, as well as a considerable quantity of molasses. Nothing is spared to increase the yield of cane fields. The usual practice is to cut canes three times, virgins, first and second ratoons, the first after 18 to 20 months, and the two ratoons each after 12 months. When the second ratoon has been cut, the stumps are dug up and burnt, the land laid fallow, and planted with some leguminous crop which is used as a green manure.

Labour is entirely Indian, coolies receive in addition to their pay, fixed rations of rice, salt-fish, lentils and salt. They work for eight hours. "Tenant farming" has been stimulated by the land-owners who let their land in small parcels for cane growing only, on condition that all the cane grown is to be weighed on the buyer's scales and market price of the district paid. The cane growers provide their own carts, oxen and mules for transporting the canes to railways or to factories, a deduction of 6 cents (nearly 3 annas) per ton per mile being made from the rent paid. Nine rupees per ton has been the usual price of the cane brought to the factory.

The varieties mostly grown are the Louzier and the white and striped Tanna. The big Tanna is one of the principal vigorous varieties that gives best results. The juice in canes is abundant, very pure and easily worked. Canes contain on an average 15 per cent. to 16 per cent. of sugar. In some plantations the yield of sugar has been $5\frac{1}{2}$ to 6 tons per acre.

B. Manufacture :—

Mauritius is in the first rank as a furnisher of white sugar to India. The majority of the estates are owned locally or by limited companies, a few being owned in England and France. Few planters have sufficient capital to work their estate without having recourse to the banks or financiers, the rate of interest being 9 per cent. upwards. Planters receive substantial assistance from the Colonial Government in the form of loan for general purposes, at a low rate of interest called the "Advance in Aid Loan of 1903," to buy up-to-date machinery. Large factories are in charge of their own chemists and others of a chemist who pays two or three visits a week. Repairs to the machinery of the factories are made at the workshops of the Island.

Triple crushing combined with maceration or spraying is almost universal, with Krajewskis splitting rolls and cane cutters. In some places twelve-roller mills have been introduced with advantage. 80 to 84 per cent. juice from cane and 90 to 95 per cent. of the sugar in cane are obtained by crushing in these mills. Losses in the manufacture have been reduced to a minimum. Coal is not used in any of the factories for steam raising.

*By-products :—*The whole of the Begasse from the mills is burnt in the green state in step grate furnaces. Few factories work distilleries. Large quantities of molasses are used for making fertilizers, and some go to the boilers to be sprayed on to the Begasse in its way to furnaces. Decided benefits have followed the use of molasses as fertilizer. The benefit is not due entirely to the plant food therein, but to the beneficial action on certain soil bacteria, such as *Azotobacter Chroococcum*. This organism has the property of fixing the nitrogen of the

air, and is apparently stimulated in its action by the presence of carbohydrates such as sugar. In order to use molasses to advantage, it is necessary to spread the molasses over as large an area as possible, and to work it into the upper layer of soil. Tentative experiments described by Mr. Ebbels show a considerable fixation of nitrogen in the soil. As a fertilizer in soils with poor drainage and low lime content, this may work more damage by fermentation and creation of unhealthy acidity than the benefit derived from the potash and nitrogen contents.

5. PERU.

A. Agriculture :—

This compares favourably with the best parts of Hawaii, all the conditions being conducive to heavy production of cane. The soil is rich and varies from fine sandy loam to silt. Sandy plains which are arid in appearance are capable of producing well if properly watered. Peru is a country without rains. Cane is grown under irrigation, the water being supplied by the rivers in the valleys fed by the snows of the Andes. Artesian wells have also been sunk to provide water to cane fields.

The best season for planting is November, the first planting taking 18 months to 2 years to mature; afterwards the ratoons ripen in 12 to 15 months. Cane cuttings are planted in furrows which are also used for irrigation. Heavy manuring is universal. The chief fertilizer used is the native Guano which is put in furrows either when planting or when the cane is a few months old. Sometimes Guano is mixed with Begasse ashes K_2SO_4 and $NaNO_3$ are also used as manures. Cane is irrigated once in 3 or 4 weeks. The earthing up of cane is done after 4 months. There are three to seven ratoon crops.

Plant crop gives 60 tons of cane per acre under in-

tense cultivation and 90 tons under very favourable conditions. Ratoons give first 25 to 40 tons, then 20 to 25 tons per acre. Sometimes 6 tons of sugar per acre are obtained. Canes contain high percentage of sucrose, low glucose and low moisture. The sugar in cane varies from 13 to 16 per cent. and the fibre from 12 to 16.5 per cent. Sugar in juice runs as high as 21 per cent.

B. Manufacture :—

The time spent in manufacture is 8 months, but the grinding may be continued all the year through. Majority of big houses use double crushing (6-roll mill) and a few more employ imbibition. Where double pressure is practised, the two mills are driven by separate engines. Rollers vary in size from 32" by 66" to 44" by 78" there are few small ones in which the proportion is 24" to 48". Triple pressure (9-roller mill), but with independent engine, is resorted to by some establishments.

With dry double-crushing the extraction of juice over the weight of cane varies from 62 per cent. to 70 per cent. with rollers 32" by 78". The sucrose extracted varies from 78 per cent. to 84 per cent. of the sucrose in cane with the double pressure.

Evaporation apparatus employed has the triple effect, but in some factories there are quadruples and in others double pans.

The cost of producing sugar is 5s-6d per cwt., *i.e.*, a little less than 8 pies per pound.

By-products.—Some burn dry bagasse, others use trash in green state as fuel for boilers and furnaces.

Molasses is generally used in the manufacture of Alcohol which can be bought at the low price of 2d per litre. Government are thinking of introducing practical

systems of using Alcohol for power, for lightening and heating purposes instead of coal a more expensive commodity.

The scums in some establishments are sent straight to a distillery with the residue of the filtered syrups, and in others the drugs go through fitter-presses until they are drained and are then baked in the form of cakes. They contain about 10 per cent. sugar. In some factories they are used as manure, in others as fodder, whilst some factories yet again use them as fuel.

6. BARBADOS.

A. Agriculture :—

The soil is naturally fertile and covers the coral formation. The area under cultivation is about 74,000 acres.

The average rainfall is 60" to 65" annually.

Cane has been extensively cultivated for the last 200 years. Canes are planted in clumps, 6ft. by 5ft at 50 lbs. to a clump.

Much has been spent for artificial manures. 40 to 80 lbs. of N ($\frac{1}{3}$ as Am SO_4 and $\frac{2}{3}$ as NaNO_3) per acre is applied, a portion shortly after the cane germinates and the remainder in June or August together with 80 lbs. to 100 lbs. of K_2O . Phosphates are not specially recommended, but, when used contain from 30 lbs. to 40 lbs. of P_2O_5 per acre. Green-soiling with leguminous crops is also done to keep up the yield.

White transport is the cane usually planted on sugar estates. B. 147 and B. 208 are also the best seedling varieties. The number of seedling canes that have given excellent results in 1909, even better than those obtained with B. 147 and B. 208 are :—B. 1753, B. 390, B. 3412, B. 3675, B. 3696, B. 3747, B. 6404, B. 6450. Not only these seedling varieties give greater yields per acre in Bar-

bados than the cane so largely planted in the past, but they are as a rule freer from the root disease. B. 3696, B. 1753 did best on black soils and the rest on red ones. The seedling varieties have given 35 to 40 tons, sometimes 60 tons, of cane per acre.

On an average White Transparent gave 6538 lbs. to 6670 lbs. of sucrose per acre and the seedling varieties from 8500 lbs. to 90,000 lbs. per acre. Canes contain on an average 13 per cent. to 13·5 per cent. of sugar. The fibre in cane varies from 12 per cent. to 16 per cent. Ratoons give 15 to 25 tons of cane and 1·5 to 2·5 tons of sugar per acre.

B. Manufacture :—

The bulk of Barbados estates make muscovado sugar. In this there is a loss of 25 per cent. of the sugar contained in the juice extracted, 13·6 tons of cane of 13·5 per cent. sugar being required to produce a ton of sugar. But with modern eleven-roller mill and complete boiling appliance even 83 per cent. of the sugar in juice could be obtained and 8·92 tons of cane of 13·5 per cent. sugar could produce one ton sugar.

The net cost of producing a ton of ordinary Barbados sugar is about £9 per ton equal to a little less than an anna per pound.

By-product.—Molascuit is prepared by mixing molasses with disintegrated megass from which the juice has been expressed. The mixture consists of 20 per cent. fine megass and 80 per cent. molasses and when finished presents a dry appearance. If 20 per cent. of the fine dry megass is used, it will readily absorb 80 per cent. of molasses and the product will not be sticky. This would stand shipment without undergoing deterioration.

The price obtained for this was sufficient to pay the West Indian planter,

7. LOUISIANA.

A. Agriculture:—

Cane is apt to suffer from frost in some years. On account of cool winters it seldom reaches maturity. The risk from storm is great. The Valleys of the river Mississippi are very fertile for sugarcane. About 400,000 acres are under cane.

Propogation is effected by planting cane stalks selected and reserved for the purpose. Seed rate is 3 tons per acre. Shallow and frequent cultivations are given to exterminate weeds. Afterwards thinning follows. Deeper ploughing is then effected by disc cultivators, which admit a deeper ventilation, and are so set as to throw the soil to the cane rows. Expenditure for labour and fertilizer amounts to about 45 per cent. of the gross income. The cost of labour has so increased during the past two decades that the industry would have declined but for the economies inaugurated in different stages of production. 400 lbs. to 700 lbs. of fertilizer is used per acre either at the time of planting or at the time of throwing the first soil to the young cane by manure distributing machines constructed to scatter the fertilizer on both sides of the row at the same time. There has been a general improvement in the preparation of land and the adoption and application of fertilizers. Much has also been accomplished in the way of reclamation by drainage and intensification by irrigation.

Cauc is a one year crop and yields from 20 to 30 tons per acre. It is not rich in sugar as the time of vegetation is limited. Fibre in cane amounts as high as 16 per cent. to 19 per cent. The research into the relative merits of cane varieties has been pursued with great assiduity.

B. Manufacture :—

There are well equipped factories under good and scientific management. The progress in the efficiency of manufacture has been more pronounced after the introduction of Vacuum pan processes. The crude and wasteful methods in vogue have been largely supplanted by new methods. With a set of corrugated rollers and two sets of three roller mills, and with maceration, 75 per cent. to 80 per cent. juice of the weight of cane and 85 per cent. to 90 per cent. of the sugar in cane are obtained. Extraction of juice from a nine-roller mill only by drycrushing amounts to 72·13 per cent. of cane. The cost of producing raw cane-sugar some what exceeds 2½ cents per pound. (more than an anna). This cost is rather high. The cost of factory equipment is estimated at \$ 250 for each ton of cane which can be milled perday, *i. e.*, a factory of 2000 tons daily capacity costs \$ 500,000 (£36299·9).

There are associations for the encouragement of cane growers and schools to teach about sugar.

By-products.—In a factory Begasse is utilised for turning out brown paper that may be used for packing purposes.

8. PORTO RICO.**A. Agriculture :—**

Soils are fertile and climate eminently suitable for sugarcane. The cultivation of cane is confined to the lower fertile land, a few miles wide, around the coast. The rainfall is not uniform as in Cuba ; the arid regions of the south and east require irrigation.

The cultivation consists in simply hoeing about three times. In nine months the main part of the leaves are stripped off the canes, and about a month before cutting thrashing is repeated. Little by little the most modern methods of culture are being introduced.

In the fields steam ploughs, harrows, and all numerous modern cane plantation tools are displacing the old ones. 48 inches of water per acre is supplied to the cane during the year at the rate of £3 per acre. Labour is cheap.

The most common varieties of cane are :—

(1) Cristalina, (2) Striped, (3) Otaheite (white) Sucrose in the cane runs from 13 per cent. to 18 per cent. The best lands yield 40 tons of cane per acre with a sugar content of 13 per cent. to 14 per cent. Cane selection and select seedling propagation are being practised on some larger estates.

B. Manufacture :—

Good factories are installed by American capital. There is co-operation to erect factories. Modern methods of manufacture are being introduced. One by one the centrals are adopting the expedient of placing the manufacture of sugar under the control of a practical sugar house chemist. Nine and twelve roller mills and in some places fifteen roller mills have been in operation. 80 per cent of juice is obtained from canes of the above named varieties in many modern centrals of the Island.

Some factories purchase or lease sufficient land to grow the canes they require and rent it to farmers afterwards purchasing the canes from them, giving them an amount of sugar equal to 5 per cent. of the canes, allowing the market price for the sugar. Other factories attend both to agricultural and manufacturing side of the business. Cultivators have found it more profitable to sell their cane than to work it up by the antiquated process. When centrals were established the manufacturers were able to offer for fresh cane a satisfactory price to cane growers. The cost of preparing a ton of sugar in the centrals comes to a little more than 9 pies per lb.

£4-0-0 cost of cane (10 tons)

£3-6-0 cost of manufacture.

£7-6-0 cost of a ton of sugar.

By-product.—Waste molasses is worked up into rum, 2½ gallons of molasses worth 6 pence, making a gallon of rum worth one shilling and six pence.

9. DEMERARA

(*British Guiana*)

A. *Agriculture* :—

Rainfall is heavy. Cultivated soils are as a rule stiff clays and are limited to lowlying marshes on the coast where the sea has to be kept out by dykes. With land freshly empoldered, the surface soil consists largely of humus and is from 12" to 18" deep. Below this lies an impervious clay sub-soil. The cane fields lie as a rule 5 or 6 ft. below sea-level, the water being pumped out into a system of canals which serve for the transport of cane and facilitate the loading of sugar for export. There are about 75,000 acres under cane.

All field work is done by hand, mechanical tillage is still in the experimental stage. The cane fields are laid out in open beds, 24 ft. to 36 ft. in width, separated by drains some 3 ft. deep and proportionately wide at the top. The cane rows run across the beds, therefore, ploughs and other tillage implements employed would have to cross a succession of wide open drains. The first class character of the cultivation in the fertile marshy coast lands of Demerara is only limited by the scarcity of labour.

Owing to the expense of draining, canes are grown continuously, being run to 3rd or 4th ratoon and there is consequently no ratoon or catch crop. As soon as the land begins to give a poor return, it is thrown out and new land put into cultivation. Fallowing is carried on to a

limited extent. There is little restoration of vegetable matter to the soil. The amount of stock is small and so the stable manure is scarce. Am. SO₄, Guano, and phosphates are generally employed as fertilizers. But these do not in the least supply humus.

Planting is done in December; the canes are cut in November or December. On coast estates with seedling canes, March or April grindings have come into existence. The practice of the thrashing off the cane before cutting has gradually spread throughout the colony.

Bourbon is the local variety. It gave in 1909, 60 tons of cane per acre on new land, though the average is not more than 25 tons per acre. It gives 1.5 to 2 tons of sugar per acre. Among the introduced seedling varieties D. 625 gave a mean yield of 45.8 tons of cane per acre when non-manured, 54.2 tons when manured with 40 lbs. of Nitrogen, and 58.2 tons when manured with 80 lbs. of Nitrogen. The introduced varieties have given 1.6 to 3 tons of commercial sugar per acre. The local variety is not very sweet.

B. Manufacture :—

Double crushing plants (6 roller mills) are in ordinary use. They extract about 70 to 75 per cent. juice from cane. By the introduction of improved machinery and by carrying on operations on a large scale under technical supervision, the cost of production of a ton of sugar has been reduced from £16 to £9 *i.e.*, from about 1 anna 8½ pies per pound to about 11½ pies per pound.

By-products.—Owing to the inferior quality of the canes molasses products, rum and Molascuit (cattle-food), are largely produced.

10. ARGENTINA.

A. Agriculture :—

Greater part of sugar is produced in the province of Tucuman. The climate of this place is sub-tropical with

an annual rainfall of about 40 inches. Temperature at noon will be 104° F. and at evening 56° F., in winter it falls below 32° F.

The soil is very deep and a rich loam. Cane is planted annually in September or October. It is only about 10 months in the ground. The whole system of cultivation is elementary in the extreme. The use of manures both natural and artificial is the exception. Pen manure is unknown as the cattle are never kept for the production of manure. Seven to ten ratoons are taken before replanting. There is no system of fallowing or proper rotation. Plants often suffer from insect pests and fungoid growths.

Labour is bad, scarce and dear. Average field-labourer gets £4 per month.

Owing to the cool climate of the country the cane is very hard, short and poor. It gives 15 to 20 tons of cane per acre at the foot of hills subject to heavy rainfall and 12 to 14 tons where the crop is artificially irrigated. Sugar in cane is about twelve per cent.

B. Manufacture :—

All up-to-date machinery is used for preparation of sugar. Three roller mills to nine-roller mills and Krajewski crusher with 10 per cent. to 15 per cent. maceration are used. With all this the amount of extraction amounts to about 70 per cent. Taking the average of 28 factories, 15.3 tons of cane were required to produce a ton of sugar in 1907, and 12.1 tons of cane to one of sugar in 1908. Argentina is able to produce sugar at the rate of £18 per ton, even with its unsuitable climate and dear labour, with the aid of large modern machinery possessing the best labour saving appliances. It comes to about a little less than As. 2 per pound. The industry is generally an artificial one and cannot compete with tropically grown sugars from Java, Mauritius, or West Indies,

By-product.—Distilleries are attached to all the estates and produce from Molasses Alcohol of 75 per cent. or 80 per cent. overproof.

11. ANTIGUA.

A. Agriculture :—

The average rainfall is 32·53", the heaviest being 41·85" and the least 25·25". The soil is heavy clay in many places. About 15,600 acres are under cane.

The cultivation of the land has always been well attended to. The addition of 40 tons of Marl to heavy clay soils of sugarcane has resulted in an increase in the yield of cane to the extent of 1·7 tons of cane per acre; the ratoon gave an increased yield of 0·9 tons of cane per acre without any additional Marl (CaCO₃).

Though the average yield of cane per acre for 5 years (from 1905-1909) was 12·61 tons, the seedling varieties, like B. 208, have given as high as 30 tons of cane per acre. The average amount of fibre in cane is 15 per cent.

B. Manufacture :—

Six-roller mill and Krajewski crusher with maceration are in use in central factories.

The contracting proprietors deliver the canes to the factory at the rate fixed beforehand, and have, moreover, an interest in the working of the factory.

By this principle the factories can have an assured cane supply. Formerly on account of the backwardness in manufacture 13½ tons of cane were required to produce a ton of sugar, but after the introduction of central factories 9·67 tons of cane suffice for producing a ton of sugar.

The following is the average of 5 years (1905-1909) in a factory consisting of six-roller mill, Krajewski crusher, a triple effect, two vacuum pans one strike mixer, five centrifugals and four filter presses,

12.61 tons of cane per acre.

1.31 tons of sugar per acre.

9.67 tons of cane were required to produce a ton of sugar.

After the introduction of Karjewski crusher the loss of sucrose in Begasse decreased from 7.74 per cent. in 1905 to 6.02 per cent in 1909. They pay 12 to 14 shillings per ton of cane and realise £ 10 to 12 per ton of sugar.

A factory with total expenditure of £52,000 and capable of turning out about 6,000 tons of sugar per year realised a gross profit of £26,600 in three years, exclusive of interest on the value of shares. This comes to 17.05 per cent. per annum on the total outlay.

The open steam on New Muscovado or Santacruz system now stands as rival for the triple and vacuum pan system. The machinery is simple and the capital expenditure is not so much. The plant costs £3,000 and is capable of dealing with six tons of cane per hour. The chief features of this system are :—

The mill is driven by a steam engine the exhaust steam from which goes for defecation and elimination. The green megass is burnt directly in special furnaces under multitubular or water-tube boilers. The juice is limed to neutrality, scum removed by elimination and then passed through a filter-press under pressure. The clear juice is evaporated in steam pans (generally of the Aspinall type) by direct steam. The megass of the cane containing 15 per cent fibre is sufficient for raising steam to drive the mill and to evaporate the juice. Mr. G.N. Sahasrabudhe asserts that this system is very useful for gul making on account of the following advantages :—

1. There will be no actual cost for extraction (either for bullocks or kerosine) as exhaust steam is used for boiling.

2. There will be better extraction as we can put 5, 6 or even 8 roller mills.

3. There will be no more gul as no juice is lost in the scum which comes out of the filter press as a dry cake.

4. There will be Gul of better quality as there is very little inversion.

12. TRINIDAD.

A. *Agriculture* :—

More than 33,800 acres are actually under cane. 37,000 to 51,000 tons of cane are produced every year though the cultivation is defective.

Trinidad grows on an average about 20 to 22 tons (long) of cane per acre. The Bourbon, white Transparent and D. 95 have given 16.4, 21.23 and 23.65 tons of cane per acre respectively. New canes in experimental station show from 18 per cent. to over 20 per cent. of sugar content.

B. *Manufacture* :—

The central factories are well-equipped for manufacture. With few exceptions advantage has been taken of modern improvements in boilers, furnaces, multiple evaporators, crushing mills, etc. Sugar is produced at the cost of £10 to £11 per ton.

By-product.—Megass is made into a paper of fairly good marketable quality. At Tacarigue modern well-equipped paper-making machines have been imported and erected. Experiments have shown that paper of better quality can be obtained by blending the megass with fibrous materials, such as Banana leaves and stems, maize, agave, Hibiscus, Bamboo, Sun-flower, native grasses and other products. The best results have been obtained from the blend of megass, bamboo and para grass.

Megass is boiled with 7 or 10 per cent. of caustic soda up to 8 hours. It yields in this manner 45 per cent. of raw fibre. The amount of bleaching powder necessary to bleach a well-boiled pulp being about 15 per cent. of powder on the dry fibre. 1 or 2 per cent. of the other chemicals are also required.

The value of megass as fuel is reckoned at 7s. 6d. per ton. For every ton of cane sugar produced there is a ton of fibrous refuse. Five tons of fibrous material would probably yield 4 tons of pulp, worth at least £ 20. If a better class of paper pulp was prepared 5 tons of fibrous material would possibly yield 3 tons, worth £36; if the megass was blended with bamboo and para grass, the pulp would be worth £ 15 per ton.

13. FORMOSA.

A. Agriculture :—

Soil is fertile. Cane is likely to suffer from the effects of frost in the part about 30° of latitude.

In many places implements used are poor; land is worked to too shallow a depth. Ploughs do not cut deeper than 4 inches into the soil. Tops of cane 8 to 9 are stuck vertically in the ground while planting. Fertilizers are used to a limited extent. Cane is not irrigated. Attention is being directed towards careful cultivation. Recently one large company has bought two steam ploughs for the cultivation of the land supplying its factory.

Sugar culture was introduced into Japan by Dutch merchants in the 17th century. Before 1898, inferior canes were grown in a rough and a careless way and the yield of cane was 15 tons per acre. Improved cane and culture brought the yield to 25 tons per acre in 1907. They are still trying to increase it to 40 tons per acre.

Rose Bamboo variety is now cultivated.

This gave about 30 tons of cane and 4 tons of sugar per acre. It is very rich and contains from 13·5 per cent. to 18 per cent. of sucrose and 10 per cent. to 12 per cent. of fibre. With complete manure, this gave 38·39 to 39·43 tons of cane and 4·5 to 5 tons of sugar per acre.

B. Manufacture :—

Before 1898 there were stone mills driven by buffaloes for the manufacture of sugar, only half the juice was extracted from the cane and less than half the sugar was extracted from the juice. Now these old mills are left and factories of more or less modern equipment have been built. Some factories rank as centrals capable of working from 150 to 1200 tons of cane daily. Some plants worked by steam power handle from 40 to 120 tons of cane daily. Modern mills secure an extraction of 70 per cent. to 75 per cent. giving an yield of 9·5 per cent. to 11 per cent. of white sugar. Powerful mills gave 78 per cent. juice and the factory will produce 11·5 per cent. sugar from the cane. A ton of cane costs 10 shillings.

Here the cane industry has been stimulated by the activity and enterprise of the Japanese Government. In 1902 with the help of experts who had studied the details of growth and manufacture of sugar in other countries, they set to work in earnest to put the Formosan sugar industry on an up-to-date basis. The native growers and makers of sugar refused to budge. They were blind to their own interests. Modern sugar factories of the highest excellence and on the largest scale were to be erected and were to buy canes from the native planters. This would no doubt give the native a much larger profit on his crop than he was getting by his barbarous method of sugar manufacture, but he positively refused to sell. He was to be supplied with improved varieties of cane and with

suitable manures, but he turned a deaf ear even to these blandishments. There was a deadlock. Gentle compulsion did wonders.

When a factory was erected it was quietly intimated to the planters in the district that they must sell their canes to the factory and no other factory or mill was to be erected in the district. On the other hand the factory was obliged to purchase the canes of the district and to give a reasonable price. The farmers soon found out that it was good business for them after all, and the system began to work more smoothly. During the last two years a fair number of first class sugar factories have started work, and a capital of more than a million sterling has already been embarked in a very paying industry. The native farmers are now so pleased that instead of their former dog-in-the-manger policy, they are keen to increase their plantings, and the factories are actually obliged to seek for fresh capital to extend their work.

This policy of gentle persuasion has been found very successful. New factories have now begun to flourish without any Government subsidy; improved canes are readily accepted and planted by native farmers; a strict observation is maintained by the officials to see that fair prices are given for canes by the factory.

14. QUEENSLAND.

A. Agricultural :—

The rainfall varies from 60" to 85" being light from June to December and heavy from January to June.

The area under sugarcane varies from 94,000 acres to 134,000 acres.

Before 1889 the yield of cane was from 40 to 46 tons per acre but in 1889 it was from 12 to 16 tons per acre and

in 1900 from 4 to 8 tons per acre. This was due to the exhaustion of the soil, plant diseases and pests, and want of labour. Intelligent cultivation and judicious use of fertilizers has restored the original producing power to these soils. The newly introduced varieties have exceeded the older varieties in agricultural and commercial results. The new Guinea varieties with good cultivation and manuring have given from 40·7 to 56 tons of cane and 5 to 10 tons of sugar per acre ; first ratoons gave on an average 42 tons of cane and 6·8 tons of sugar per acre.

Mr. R. H. Paul's cane-cutter is worthy of notice. This machine weighs 3 lb. and is worked by compressed air supplied by a portable oil engine, compressor and air receiver. This contains Guttapercha tubing conveying the air and a chisel with three-inch blade. This machine works with minimum of physical exertion, operates below the ground and does 3 or 4 times the work of ordinary cane cutter. The cutter and hose cost £3. With a portable engine ten cutters may be operated simultaneously.

B. Manufacture :—

An extraction varying from 91·9 per cent. to 97 per cent. of the sugar in cane is regularly obtained from the canes crushed in nine-roller mills and in some cases nine-roller mill has been superseded by the twelve-roller mill with satisfactory results. As adjuncts to the milling plant, various crushing devices have been added, such devices are indispensable when working certain varieties of cane.

The cost of producing a ton of sugar is £8-15-0, 10s. 6d. being paid per ton of cane.

By-product.—The *molasses* is used principally in the manufacture of rum. Some factories are burning their molasses along with the *megass* to save wood,

15. MEXICO.

A. Agriculture :—

The climate and soil are favourable to sugar-cane cultivation. Where rainfall is moderate, irrigation is in practice. In low-lying coast regions no irrigation is needed.

Advanced methods of planting and harvesting are being introduced. Repeated ploughing, irrigating and using stable manure are the rule.

The average yield of cane is from 30 to 45 tons per acre, in exceptional cases 60 tons per acre.

B. Manufacture :—

Formerly the power for mills was supplied by mules and oxen. The primitive modes of manufacture, the scarcity and indifferent quality of the labour, and the high cost of transport have prevented the expansion of the industry. As foreign capital is invested great progress has been made in the industry. Modern mills and refineries have been erected. First, three-roller mills operated by steam power were introduced; then, immense twelve roller mills extracting more than 95·5 per cent of the saccharine matter were planned. The cane goes through 4 sets of three-rollers each, very little saccharine matter being left in the cane. An import tax of 1½*d.* per pound, recently placed by Government, has further stimulated the production.

Associations are organised for the encouragement and protection of cane-growers.

16. EGYPT.

A. Agriculture :—

The climate is favourable and the soil is rich, the country is well adapted to sugar cultivation.

Egypt produces from 40,000 to 60,000 tons of sugar

every year. In the Zambesi valley the output of sugar is increasing every year. It has increased from 3,000 tons in 1907 to 20,000 tons in 1910.

The varieties of sugarcane principally employed are the Ribbon Bamboo and Uba. Uba is regarded as the most satisfactory. This yields on an average about 3 tons of sugar which is valued at 13s. per cent. The average plantings yield about 22 tons per acre in the first year and nine tons per acre in the second year. The sugar content of cane varies from 10·5 per cent. to 13·9 per cent in the first year, and from 12·0 per cent. to 14·0 per cent in the second year. In frosty years the sugar content is reduced.

B. Manufacture :—

The yield of sugar per hundred of cane was 9·43 in 1905 and 10·16 in 1906 in the factories. The cost of producing one ton of sugar is £9-10-11.

17. NATAL.

A. Agriculture :—

The planting season is from September to November. The crop is ready about twenty one months after planting and generally three crops are taken. First crop gives at least 2½ tons of sugar per acre and the succeeding crops not less than 1½ tons. The yield varies greatly in dry seasons. Uba cane is grown, which has extreme hardness and high fibre content.

B. Manufacture :—

Eleven and fourteen roller mills are at work for efficient crushing of this hard Uba cane. Natal produced seven years ago, 30,000 tons of sugar; in 1909, 70,000 tons; in four years it is hoped to produce 100,000 tons. This large increase in production is owing to new factories having been put up and to the introduction of modern

eleven or fourteen roller mills into older factories where hitherto only six-roller mills have been employed. The pioneers in 1850 had neither the practical knowledge requisite nor the necessary capital.

18. SPAIN.

A. Agriculture :—

The cultivation of sugarcane dates from the time of the Moorish conquest. Spain is the only cane sugar country in Europe. The main development of the cultivation is along the coast where, sheltered from the north winds by a chain of mountains, the temperature is high and there is an absence of frost.

As much as 10,000 sets are planted per acre. Stable dung, Superphosphate of lime, Ammonium sulphate, Sodium Nitrate, fish, Guano, Basic slag are the manures used. Best results are obtained by applying the Basic slag before deep ploughing ; the Guano, the Superphosphates and two-thirds of Ammonium sulphate in the trenches before planting ; and the rest of the Ammonium Sulphate and Sodium Nitrate as a covering before earthing up the young plants. In case of ratoons manure is scattered over the ground and the soil is loosened by passing the plough-share as near the stumps as can be done without damaging them.

Irrigation is given during dry season which lasts for 3 or 4 months, every 10 or 15 days, each time about 2,367 C. ft. of water per acre.

The cultivation is the most remunerative occupation in Spain, in spite of the high cost of production. Cane fetches from 24 shillings to 32 shillings per ton delivered at the factory.

White variety yields from 18 to 20 tons ; the mean sucrose content of this may reach as high as 15 per cent,

with glucose content of 0.6. Red variety yields as high as 32 tons of cane per acre; the sucrose content of this is inferior to that of the white variety, the mean being 13 per cent. to 14 per cent. with 0.5 per cent. to 1.2 per cent. of glucose.

19. INDIA.

Referring to the above noted details about all the cane-growing countries, it clearly appears that India is not inferior to them as a grower of sugarcane. Her climate is suitable, soil fertile, cultivation not bad, facilities for irrigation fairly good, labour cheap and abundant, cane rich and juicy, and the yield of cane per acre not low as in many countries but compares favourably with the best cane producing localities of the world. Dr. Leather says, "There is no need to go outside India for good varieties nor to other countries for good methods of cultivation. The best of varieties are met with; and the methods of cultivation in some parts are very perfect. What is wanted is the introduction of these good varieties and good methods into those parts, particularly the North-Western Provinces and Behar, which Provinces it must be recollected, include much the largest area under cane of any provinces of India."

Notwithstanding her facilities no one can ascertain whether an area yields a ton, or half a ton, or two tons of sugar. This is due to defective cultivation crude methods of extraction, boiling and manufacture. The agricultural side of the industry (about cultivation, manure, etc.,) has already been taken into consideration, and what now calls for aid is the manufacturing side.

Fibre in cane varies from 8.5 per cent. to 15 per cent. according as the variety is thick or thin. Juice in these varieties also varies from 85 per cent. to 91.5 per cent.

Even with the best of mills, a cane containing 85 per cent. juice yielded only 45 per cent. and the cane containing 91.5 per cent. juice, gave only 72 per cent. This means that a cane with 15 per cent. fibre held 40 per cent. juice and the one with 8.5 per cent. fibre held 19.5 per cent. juice. As a result of this it may be said that for each part of the fibrin the fresh cane will hold twice to two and a half times its own weight of juice when pressed, and allow only the surplus to run out.

In other cane-growing countries, from canes having the fibre content of 12 per cent. to 15 per cent. 69.05 per cent. to 76.19 per cent of juice is obtained with dry doubles (two three-roller mills). In large factories trebles (three three-roller mills) are used in train. These mills with the addition of 12 per cent to 15 per cent. of water give diluted juice equal to the yield of 79.05 per cent to 86.19 per cent of the undiluted juice from canes containing 88 per cent. to 90 per cent. of juice.

The following is the composition of one hundred parts of megass in Poona with the best three-roller mill as compared to that of other countries under different treatments.

Megass.	Poona Mill.	Double Milling and maceration.	Triple Milling and maceration.	Diffusion (Chip express.)
Fibre.	29 to 30	39.2	41.3	45.5
Juice.	70 to 71 (of which more than 10 is sugar.)	60.8 (of which 6.3 is sugar.)	58.7 (of which 4.2 is sugar.)	54.5 (water only.)

This shows the wastefulness of the native method of

extraction. If the extraction is rendered more efficient, the losses of sugar could be minimised.

A maximum of pressure with a minimum of maceration is used in foreign countries. This not only means a higher extraction but it will secure a greater expression of the natural juice ; and that finally means a juice of higher quality, and from which a greater proportion of the sugar in the juice is obtainable. The first crushing, with soft and juicy varieties, obtains an extraction of about 80 per cent. of the pith juice and an extraction of nothing to a small quantity of rind tissue, and any rind tissue juice that is expressed is obtained in the later mills. Milling process is very effective so far as regards the soft inferior pith, but very crude as regards the extraction of sugar from the hard outer rind. An increased extraction is obtained in other countries by any of the following methods :—

(1) Higher pressure resulting in the greater rupture of the rind tissue. This will give higher expression and a material more suited for the absorption of water.

(2) More effective disintegration of the rind tissue to be obtained by the use of knives, shredders, crushers, or heavily indented rollers.

(3) More rational means of applying the added water such as by the use of a series of injectors in the place of a perforated pipe, or by the use of macerating baths through which the begasse is drawn.

Not only does the loss occur in milling but also in the concentration of juice. If the juice is boiled to unnecessarily high temperature, the coming syrup will, on account of inversion, to a considerable extent lose its power of crystallization causing much of the available sugar to go with molasses. The methods of concentration with Vacuum pans, Bath evaporators, etc., in factories will not only hinder this loss but also cause proper granulation.

Besides this, wastage happens also in the separation of the impurities from the juice. The scums have been treated as if worthy of no more attention than was necessary to get them decently out of the way. They contain from 6 per cent. to 10 per cent. of sugar and if not properly cared for entail a loss of from 0.05 per cent to 0.15 per cent on cane. As the process of concentration goes on the richness of the scums in sugar progresses with that of the syrup. It is well to endeavour to recover the vast quantities of sugar which are annually thrown away in the scums. In up-to-date factories this loss is avoided by the use of filter-press. Even the first scums can be profitably washed through filter press, and with the subsequent skimmings the operation is still more useful.

The preparation of sugar according to primitive methods is not only wasteful but expensive. Even if it be assumed that the crop was only 25 tons per acre and that the cane carried only 10 per cent. sugar, the yield would be $2\frac{1}{2}$ tons of sugar per acre. In order to produce sugar cheaply, the establishment of sugar factories in convenient places on an up-to-date basis is a desideratum. The best sugar authorities maintain, "Were modern machinery installed in the place of the antiquated conglomeration of wheels and rollers at present to be met with, the sugar production of India could be doubled with little or no difficulty. Of the world's total output of sugar, namely, 8,340,000 tons of cane (and 6,940,000 tons of beet) India is responsible for 3,000,000 tons or nearly 39 per cent of the whole. Were modern machinery instead of the ancient one utilized, India could produce more than one-half of the world's supply. Neither need the area of cultivation be extended by a single acre; but, on the other hand, were the existing fields of cane properly manured and scientifically cultivated, the product would be 100 per cent,

above what it is to-day, and with a very much higher percentage of juice."

Factories call for the following requirements: --

1. Co-operation.
2. Suitable situation.
3. Expert managers.
4. Proper use of by-products.

1. Factories will work successfully and make substantial profits if they are run on co-operative basis. The cultivation of sugar-cane by farmers in co-operation with central factories will prove to be highly satisfactory. Now the planter has to be both the farmer and the manufacturer which explains the poor condition of the industry. Cultivator should be quite independent of the manufacturer so that he may be able to devote his whole time to the growth and improvement of cane. Then co-operation should be formed. The capital should be subscribed by share-holders who should receive a dividend say of 5 or 6 per cent., on their money. In addition to these shares there should be shares, the holders of which should be bound to provide some tons of sugarcane per share at a price fixed at the beginning of each campaign. Any profits available after meeting the expenses, the 5 or 6 per cent. dividend, etc. should be equally divided among all the share-holders (the money share-holders and the sugarcane share-holders). If the sugarcane holders fail to carry out their contract they should forfeit their share for the year in the profits of the company, or in some cases pay a fine proportionate to the shortage of their contribution. In some cases money may be advanced, implements or manures may be provided by the company to the growers on condition of their supplying cane to the factory at a price reasonably fixed beforehand. This system will give control over the sugarcane crop for the successful working

of the factory. In order that such excellent results as are obtained in Java, Formosa, etc., may also be realised in India, Co-operation should be insisted upon between cane-growers and sugar factories.

Cultivators will continue to make Gul till they find it advantageous to sell cane or join the co-operation. First of all some factories should be set up which should be capable of working on cane during one-third of the year and on Gul during two-thirds. Such combined factories would work at a relatively low-rate of profit during two-thirds of the year and at a higher rate during one-third. Central factories should then be gradually brought into existence. When these are established it will pay manufacturers to offer for fresh cane such a price as will lead to the abandonment of Gul making. When foreign capital came into play, cultivators at Porto-Rico found it more profitable to sell their cane than to work it up by the old process. Under similar conditions Gul available for refining in India will tend to become more rare and cane will be offered in its place.

A combined factory with daily output of 20 tons would cost about Rs. 350,000 ; an up-to-date factory for preparing sugar directly from cane with daily output capacity of 20 tons of sugar, about Rs. 300,000 ; and a small one able to work on 100 acres about Rs. 60,000.

2. On account of the scattered distribution of the cane crop, the large factories of the type existing in Java and Hawaii have a chance of success in a limited number of places; but there is no reason why a small and efficient plant working from 100 to 200 acres of cane in the season, and employing vacuum pan evaporation and improved methods of clarification, should not succeed in many places. In all countries where cane is produced on a

competitive footing factories are put in the centre of sugarcane tracts. The cane will be as near the mill as possible and so will not deteriorate before reaching the rolls. Good roads leading to factory, a railway siding hard by, and a good supply of water either from canal or river are also taken into consideration before setting up a factory. The following tables given by Mr. F. Noel-Paton about each of the provinces of India will give some clue as to the localities where factories, either big or small could be satisfactorily set up :—

ASSAM :—

No.	District.	Total area of District in acres.	Area under sugarcane in acres.	Population of District.	No. of sugar factories.	Neighbouring large towns.	
						Name.	Population.
1	Cachar ...	2,412,160	5,250	414,781	...	...	...
2	Sylhet ...	3,483,200	20,000	2,241,848	...	...	...
3	Goalpara ...	2,535,040	1,000	462,052	...	...	...
4	Kmrup ...	2,469,120	3,688	589,187	...	...	...
5	Darrang ...	2,187,520	2,176	337,313	...	...	...
6	Nowgong ...	2,459,206	2,043	261,160	...	...	...
7	Sibsagar ...	3,197,331	6,925	597,969	...	...	...
8	Lakhimpur.	2,692,480	3,783	371,396	...	...	...
9	Naga Hills.	1,965,011	...	102,402	...	...	...
10	Khasi and Jaintia Hills.	1,298,880	...	202,250	...	...	...
11	Garo Hills...	2,009,792	4	138,274	...	...	...
12	Lushai Hills.	4,625,280	...	8,434	...	...	...
Total ...		31,335,020	44,869	5,801,066	...	...	...

BENGAL :—
(INCLUDING EASTERN BENGAL)

Number.	District.	Total area of District in acres.	Area under sugarcane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
1	Bardwan	1,720,960	26,000	1,532,475	...	Bardwan ...	85,022
2	Bankura ...	1,677,440	12,800	1,116,411	...	Bankura ...	20,737
3	Birbhum ...	1,121,280	8,900	902,280	...	...	...
4	Midnapur ...	3,319,040	18,400	2,789,114	...	Midnapur ...	33,140
5	Hooghly ...	1,088,610	14,300	1,899,796	...	Hooghly ...	29,383
						Serampur	44,451
						Howrah ...	157,594
6	24 Parganas (a) ...	3,100,160	9,100	2,078,350	1	Calcutta & Subarbs	1,026,987
						Naihati & Bhatpara.	45,293
7	Khulna ...	3,049,542	17,600	1,253,043	...	...	...
8	Nadia ...	1,787,520	6,800	1,667,491	5	Krishnagar.	21,547
						Santipur..	26,898
9	Jessore ...	1,872,000	28,400	1,813,155	10	...	...
10	Murshidabad ...	1,371,520	14,200	1,333,184	...	Berhampur...	24,397
11	Dinajpur ...	2,525,440	25,000	1,567,080	...	...	...
12	Rajshahi ...	1,659,520	18,500	1,462,407	...	Rampur—	...
						Boalia ...	21,589
13	Rangpur ...	2,235,520	22,300	2,154,181	1	...	...
14	Bogra ...	869,760	18,300	854,533	...	...	...
15	Pabna ...	1,176,960	4,200	1,420,461	...	Sirajganj ...	23,114
16	Darjeeling	744,960	200	249,117	...	...	...
17	Jalpaiguri...	1,895,680	4,700	797,380	...	...	...
18	Dacca ...	1,780,420	19,800	2,649,522	...	Dacca ...	90,542
						Narainganj.	24,472
19	Faridpur ...	1,459,840	25,000	1,937,646	...	...	...
20	Backerganj.	2,506,880	18,500	2,291,752	...	...	...
21	Maimensingh ...	4,052,480	20,600	3,915,068	...	...	...
22	Tippera ...	1,539,360	7,900	2,117,991	...	...	...
23	Noakhali ...	1,057,160	600	1,141,728	...	...	...
24	Chittagong.	1,594,815	9,000	1,353,250	...	Chittagong	22,140
25	Patna ...	1,323,000	20,000	1,624,985	...	Patna ...	134,785
						Bihar ...	45,063
						Dinajpur ...	83,699
26	Gaya ...	3,015,830	30,400	2,059,933	...	Gaya ...	71,288
27	Shahabad.	2,798,720	34,100	1,962,696	4	Arrah ...	46,170
						Sassaram ...	23,644
28	Darbhanga.	2,142,690	16,000	2,912,671	...	Darbhanga	66,244
29	Muzaffarpur	1,942,400	9,200	2,754,790	1	Muzaffarpur	45,617
						Hajipur ...	21,398

(a) Excluding Calcutta.

BENGAL (Continued)

Number.	District.	Total area of District in acres.	Area under sugarcane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
30	Saran ...	1,711,286	45,800	2,409,509	1	...	...
31	Champanan ...	2,259,840	10,500	1,790,463	7	Bettiah ...	24,696
32	Monghyr ...	2,510,080	7,200	2,068,804	...	Monghyr ...	35,880
33	Bhagalpur ...	2,704,640	64,900	2,088,958	...	Bhagalpur ...	75,700
34	Purnea ...	3,196,153	7,000	1,874,794	...	...	...
35	Malda ...	1,215,360	3,100	884,030	...	...	...
36	Santhal Par- ganas ...	3,500,800	13,600	1,809,737	...	...	...
37	Cuttack ...	2,338,560	4,000	2,062,758	...	Cuttack ...	51,364
38	Balasure ...	1,334,368	2,000	1,071,197	...	Balasure ...	20,880
39	Angul ...	1,075,840	2,300	191,911	...	...	...
40	Puri ...	1,599,360	2,500	1,017,284	...	Puri ...	49,334
41	Hazaribagh.	4,493,440	35,600	1,177,961	...	...	...
42	Ranchi ...	4,561,920	300	1,187,925	...	Ranchi ...	25,970
43	Palaman ...	3,144,960	4,200	619,600	...	...	...
44	Manbhum ...	2,654,080	12,000	1,301,364	...	...	...
45	Singhbhum.	2,490,240	1,000	613,579	...	...	...
	Total ...	97,680,374	676,800	73,772,308	30	...	...

BOMBAY AND SIND :—

Bombay :—							
	Ahmedabad.	2,442,358	1,493	795,967	...	Ahmedabad	185,882
1	Kaira ...	1,021,379	312	716,332	...	Nadiad.	31,435
P a n c h -							
2	Mahals ...	1,028,147	51	261,020	...	Godhra. ...	20,915
3	Broach ...	939,683	63	291,763	...	Broach. ...	42,896
4	Surat ...	1,056,378	3,562	637,017	...	Surat ...	119,306
5	Khandesh...	6,445,427	1,474	1,427,382	...	Dhulia. ...	24,726
6	Nasik ...	3,747,949	6,207	816,504	...	Nasik ...	21,490
A h m e d -							
7	nagar ...	4,220,388	2,188	837,695	...	Ahmednagar	42,032
8	Poona ...	3,423,981	9,101	995,330	...	Poona ...	153,327
9	Sholapur ...	2,909,891	1,928	720,977	...	Sholapur ...	72,288
P a n d h a r p u r							
10	Satara ...	3,092,601	12,846	1,146,559	...	Satara ...	26,022
11	Belgaum ...	2,976,213	10,545	998,976	...	Belgaum ...	36,878
12	Bijapur ...	3,628,835	748	735,435	...	Bijapur. ...	23,811
13	Dharwar ...	2,946,281	2,140	1,113,298	...	Dharwar ...	31,276
H u b l i							
14	Thana ...	2,285,120	562	811,433	1	Bandra ...	60,214
B o m b a y							
15	Kolaba ...	1,068,014	22	605,566	...	...	22,075
16	Ratnagiri ...	2,554,556	(a) 294	1,167,927	...	...	776,006
17	Kanara ...	2,525,151	2,935	454,490	...	...	...
18	Total ...	42,612,352	56,421	14,528,671	1	...	...

(a) Relates to about a fifth of the District for which crop statistics are available.

SIND :—

Number.	District.	Total area of District in acres.	Area under sugarcane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
	Sind :—						
1	Karachi ...	7,661,753	980	446,511	...	Karachi ...	116,663
2	Hyderabad.	5,086,577	1,024	963,210	...	Hyderabad.	69,378
3	Sukkur ...	3,455,203	318	523,345	...	Shikarpur ... Sukkur ...	49,491 81,316
4	Larkana ...	3,230,717	163	656,083	...	...	...
5	Upper Sind Frontier.	1,688,309	35	232,045	...	...	...
6	Thar & Parkar ...	8,921,639	175	389,714	...	...	...
	Total ...	30,044,197	2,695	3,210,910	...	...	...

UPPER BURMA :—

1	Pokokku ...	3,974,793	10,770	356,489	...	...	...
2	Mimbu ...	2,113,811	446	233,377	...	...	...
3	Magwe ...	2,120,738	873	246,708	...	...	...
4	Mandalay.	1,363,859	110	366,507	...	Mandalay	183,816
5	Bhamo ...	2,618,240	8	79,515	...	...	...
6	Myitkyina.	6,433,792	10	67,399	...	...	...
7	Katha ...	4,480,640	2	176,223	...	...	...
8	Ruby Mines	1,196,550	...	87,694	...	...	...
9	Shevebo ...	3,605,760	2,920	286,891	...	...	...
10	Sagaing ...	1,191,494	1,059	282,658	...	...	...
11	Lower Chindwin.	2,227,200	2,366	276,383	...	...	...
12	Upper Chindwin.	10,984,198	5	154,551	...	...	...
13	Kyankse ...	815,331	2,844	141,253	...	...	...
14	Meiktila ...	1,308,678	330	252,305	...	...	...
15	Jamellin ...	2,628,965	1,636	248,197	...	...	...
16	Myingyan.	1,917,991	9,080	356,052	...	...	...
	Total ...	49,042,040	32,459	3,607,202	...	...	...

LOWER BURMA:—

Number.	District.	Total area of District in acres.	Area under cane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
1	Akyab ...	3,287,040	261	481,666	...	Akyab ...	85,680
2	Northern Arakan ...	3,349,120	...	20,682	...	...	...
3	Kyankpyu.	2,807,680	608	168,827	...	...	...
4	Sandoway.	2,421,760	705	90,927	...	...	...
5	Rangoon town ...	18,106	...	234,881	...	Rangoon ...	234,881
6	Hanthawaddy ...	1,950,988	131	484,811	...	...	...
7	Peru ...	2,818,091	183	339,572	...	...	...
8	Tharawaddy ...	1,832,320	564	395,570	...	...	...
9	Prome ...	1,865,668	310	365,804	...	Prome ...	27,375
10	Maubin ...	1,054,707	127	484,410	...	...	...
11	Pyapon ...	1,375,032	104	...	...	...	...
12	Bassein ...	2,641,036	193	391,427	...	Bassein ...	31,864
13	Henzada ...	1,835,133	547	484,558	...	Henzada ...	24,756
14	Myaungmya ...	1,691,344	447	303,274	...	...	...
15	Thayetmyo.	3,040,032	40	239,706	...	...	...
16	Toungoo ...	3,950,080	1,464	279,315	...	...	...
17	Salween ...	1,706,240	149	37,837	...	...	...
18	Thaton ...	3,134,262	4,311	343,510	...	...	...
19	Amherst ...	4,519,680	689	300,173	...	Moulmein ...	58,446
20	Tavoy ...	3,397,120	96	109,979	...	...	...
21	Mergui ...	6,264,960	81	88,744	...	...	...
	Total ...	54,963,401	11,005	5,645,673	...	...	...

CENTRAL PROVINCES AND BERAR:—

1	Saugor.	2,554,891	396	471,046	...	Saugar ...	42,330
2	Damoh ...	1,811,840	213	285,326	...	...	...
3	Jabulpore.	2,503,751	987	680,585	...	Jabulpore	90,816
4	Mandla ...	3,238,988	480	317,250	...	...	...
5	Sconi ...	2,152,021	475	327,709	...	...	...
6	Narsinghpore ...	1,235,829	885	313,951	...	...	...
7	Hoshangbad ...	2,353,024	124	449,165	...	...	...
8	Nimar ...	2,734,618	74	327,035	...	Burhanpur...	35,341
9	Batal ...	2,448,574	2,315	285,363	...	...	...

CENTRAL PROVINCES AND BERAR (Continued).

Number.	District.	Total area of District in acres.	Area under cane in acres	Population of District.	No. of sugar Factories.	Neighbouring large towns.	
						Name.	Population.
10	Chhindwara ...	2,963,907	1,553	407,927	...	...	...
11	Wardha ...	1,553,920	42	385,103	...	...	...
12	Nagpur ...	2,457,565	96	751,844	...	Nagpur ...	127,734
						Kamptee ...	38,888
13	Chanda ...	6,875,635	1,068	601,533	...	...	...
14	Bhandara ...	2,539,520	2,261	663,062	...	...	...
15	Balaghat ...	1,999,998	1,537	326,521	...	...	...
16	Sambalpur ...	3,166,720	5,136	829,698	...	...	...
17	Raipur ...	7,503,360	795	1,440,556	...	Raipur ...	32,114
18	Bilaspur ...	5,338,240	2,799	1,012,972	...	...	...
	Total ...	55,332,391	21,239	9,876,646	...	...	...
	Berar :—						
1	Akola ...	1,701,754	206	5,25,540	...	Akola ...	29,289
2	Amraoti ...	1,965,904	203	630,118	...	Amraoti ...	34,216
3	Basin ...	1,890,473	342	353,410	...	...	...
4	Buldana ...	1,797,385	922	423,616	...	...	...
5	Ellichpur ...	1,674,816	63	297,408	...	Ellichpur ...	26,082 ..
6	Wun ...	2,502,298	350	466,929	...	...	...
	Total ...	11,332,580	2,076	2,754,016	...	...	...

MADRAS :—

1	Ganjam ...	5,856,224	1,739	2,010,256	1	Berhampur.	25,729
2	Vizagapatam ...	11,022,714	6,754	2,938,650	...	Vizagapatam	40,892
						Vizianagram	37,270
3	Godawari...	3,585,602	6,285	2,301,759	1	Cocanada ...	48,096
						Rajamundry	36,408
						Ellore ...	53,521
4	Kistna ...	3,734,842	2,578	3,651,790	...	Magulipatam	99,507
5	Guntur ...	3,670,373	440		...	Guntur	30,833
6	Nellore ...	6,097,300	846		...	Bezwada ...	24,224
						Nellore ...	52,040
7	Karnul ...	4,849,767	4,653	872,655	...	Karnul ...	25,376
8	Bellary ...	3,656,230	8,094	947,214	...	Bellary ...	58,247
						Adoni ...	30,416
9	Anantapur ...	3,556,083	2,722	788,254	...	...	...
10	Cuddapah ...	5,582,739	7,325	1,291,267	...	...	...
11	North Arcot ...	4,721,849	8,986	2,207,712	8	Vellore ...	43,537

MADRAS (Continued).

Number.	District.	Total area of District in acres.	(a) Area under cane in acres	Population of District.	No. of sugar Factories.	Neighbouring large towns.	
						Name.	Population.
12	Chingleput.	1,971,041	1,122	1,312,122	...	Conjeeveram ...	46,168
						Gudiyattam.	21,385
13	Madras ...	17,210	...	509,346	...	Madras ...	509,346
14	South Arcot	3,339,520	7,537	2,349,894	2	Cuddalore ...	52,216
15	Salem ...	4,818,982	5,008	2,204,974	...	Salem ...	70,621
16	Coimbatore	5,030,790	8,531	2,201,752	1	Coimbatore.	53,080
17	Trichinopoly ...	2,324,804	6,245	1,414,770	...	Trichinopoly.	104,721
						Srirangam ...	23,089
18	Tanjore ...	2,375,886	2,752	2,245,029	...	Kumbakonam ...	59,673
						Tanjore ...	57,840
						Negapatam...	57,190
						Mayavaram.	24,276
						Mannargudi.	20,449
19	Madura ...	5,558,896	17,601	2,831,280	...	Madura ...	105,984
						Dindigul ...	25,182
						Aruppukottai	23,633
						Bodina yakka-nur ...	22,209
20	Tinnevelly.	3,448,922	48,404	2,059,607	8	Trinnevelly.	40,469
						Palamcottah.	89,545
						Tuticorin ...	28,048
						Srivilliputtur.	26,382
						Tiruchendur.	26,056
						Rajapalayam ...	25,360
21	Nilgiris ...	612,557	...	111,437	...	...	...
22	Malabar ...	3,708,692	4,054	2,790,281	...	Calicut ...	76,981
						Palghat ...	44,177
						Tellicherry.	27,883
						Cannanore.	27,881
23	South Canara ...	2,573,889	1,418	1,134,713	...	Mangalore.	44,108
	Total ...	90,673,912	153,074	38,199,162	11	...	...

(a) Relates to about two-thirds of the Province for which crop statistics are available.

NORTH-WEST FRONTIER PROVINCE.

Number.	District.	Total area of District in acres.	Area under cane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
1	Hazara ...	1,915,818	1,094	560,288	...	...	...
2	Peshawar ...	1,667,392	18,414	788,707	...	Peshawar	95,147
3	Kohat ...	1,670,208	46	217,865	...	Kohat	30,762
4	Bannu ...	1,070,093	6,387	231,485	...	...	...
5	Dera Ismail-khan ...	2,174,047	62	252,379	...	Dera Ismail-khan	31,737
	Total ...	8,497,558	26,003	2,050,724	...	...	...

PUNJAB :—

1	Hissar ...	3,337,113	294	781,717	...	Bhiwani ...	35,917
2	Rohtak ...	1,150,080	24,434	630,672	...	Rohtak ...	20,323
3	Gurgaon ...	1,269,760	7,557	746,208	...	Gurgaon ...	27,295
4	Delhi ...	825,600	17,576	689,039	...	Delhi ...	208,575
5	Karnal ...	2,017,920	19,553	883,225	...	Panipat ...	26,914
					...	Karnal ...	23,559
6	Ambala ...	1,184,680	15,870	815,880	...	Ambala ...	78,638
7	Simla ...	64,600	...	40,351	...	...	...
8	Kangra ...	6,385,920	4,829	768,124	...	...	...
9	Hoshiarpur.	1,436,160	24,021	989,782	...	...	...
10	Jalandhar ...	915,825	27,997	917,587	...	Jalandhar ...	67,735
11	Ludhiana ...	931,215	9,692	673,097	...	Ludhiana ...	48,649
12	Ferozepur.	2,743,190	1,507	958,072	...	Ferozepur ...	49,341
13	Multan ...	3,908,738	1,141	610,626	...	Multan ...	87,394
14	Jhang	4,177,233	31,631	791,861	...	J h a n g - Maghiana.	24,382
15	Lyallpur						
16	Montgomery ...	3,009,023	411	463,586	...	Lahore ...	202,964
17	Lahore ...	2,370,590	6,554	1,162,109	...	Kasur ...	22,022
18	Amritsar ...	1,024,640	16,545	1,023,828	...	Amritsar ...	162,429
19	Gurdaspur	1,208,960	51,590	940,354	1	Batala ...	27,365
20	Sialkot ...	1,274,240	34,919	1,083,909	...	Sialkot ...	57,956
21	Gujrat ...	1,312,640	6,694	750,548	...	...	...
22	Gujranwalla ...	2,044,049	20,492	756,797	...	Gujranwalla.	29,224
23	Shahpur ...	3,234,537	2,641	524,259	...	...	...
24	Jhelum ...	1,800,320	233	1,524,553	...	Rawalpindi.	87,688
25	Rawalpindi.	1,286,400	116				
26	Attock ...	2,574,080	1,557	424,588	...	...	...
27	Mianwali ...	4,998,844	103				
28	Dera Ghazi-khan ...	3,407,945	83	471,149	...	Dera Ghazi-khan ...	23,731
29	Muzaffargarh ...	2,326,342	5,392	405,656	...	...	...
	Total ...	62,220,644	333,231	22,431,732	1	...	...

UNITED PROVINCES OF AGRA AND OUDH:—

Number.	District.	Total area of District in acres.	Area under cane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
1	Dehra Dun.	769,520	1,083	178,195	...	Dehra ...	28,095
2	Saharanpur.	1,425,920	47,580	1,045,230	...	{ Saharanpur Hardwar Deoband	86,254 25,597 30,167
3	Muzaffarnagar ...	1,056,711	79,983	877,188	...	Muzaffarnagar ...	33,444
4	Meerut ...	1,511,680	127,767	1,540,175	...	Meerut ...	118,129
5	Bulandshahr ...	1,214,134	88,861	1,138,101	...	Khurja ...	29,277
6	Aligarh ...	1,252,480	5,109	1,200,822	...	{ Koil ... Hathras ...	70,434 42,578
7	Muttra ...	932,480	2,245	763,099	...	Muttra ... Brindaban ...	60,042 22,717
8	Agra ...	1,187,840	1,211	1,060,528	...	Agra ...	188,022
9	Farukhabad ...	1,100,160	17,859	925,812	...	Farukhabad.	67,338
10	Mainpuri ...	1,086,080	10,078	829,357	...	...	...
11	Etawah ...	1,084,160	9,572	806,798	...	Etawah ...	42,570
12	Etah ...	1,107,074	17,036	868,948	...	...	...
13	Bareilly ...	1,018,318	50,182	1,090,117	...	Bareilly ...	131,208
14	Bijnor ...	1,194,511	77,832	779,951	...	Nagina ...	21,412
15	Budaun ...	1,273,865	17,837	1,025,753	...	Budaun ...	39,031
16	Moradabad.	1,473,566	46,096	1,191,993	...	{ Moradabad Amroha ... Sambhal ... Chandansi.	75,128 40,077 39,715 25,711
17	Shahjanpur.	1,117,941	40,168	921,535	1	Shahjanpur.	76,458
18	Pilibit ...	878,642	40,806	470,339	...	Pilibit ...	33,490
19	Cawnpore.	1,514,368	7,783	1,258,868	1	Cawnpore ...	197,170
20	Fatehpur ...	1,043,840	4,507	686,391	...	...	...
21	Banda ...	1,959,168	4	631,058	...	Banda ...	22,565
22	Hamirpur ...	1,464,704	1,074	458,542	...	...	...
23	Allahabad.	1,813,184	10,931	1,489,358	...	Allahabad ...	172,082
24	Jhansi ...	2,295,870	505	616,759	...	Jhansi ...	55,724
25	Jalaum ...	945,534	63	399,726	...	...	...
26	Benares ...	646,061	15,748	882,084	...	Benares ...	209,331
27	Mirzapur ...	3,342,720	* 7,563	1,082,430	...	{ Mirzapur with Bindachal.	79,862
28	Jaunpur ...	992,640	40,449	1,202,920	...	Jaunpur ...	42,771
29	Ghazipur ...	890,277	25,822	913,818	...	Ghazipur ...	39,429
30	Balia ...	790,438	38,917	987,768	...	...	...
31	Gorakhpur.	2,908,275	86,542	2,957,074	...	Gorakhpur.	64,148
32	Basti ...	1,751,795	50,952	1,846,153	...	...	...
33	Azamgarh.	1,407,215	66,241	1,529,785	...	...	...
34	Almora ...	3,466,267	...	465,893	...	...	...

UNITED PROVINCES OF AGRA AND OUDH (Continued).

Number.	District.	Total area of District in acres,	Area under cane in acres.	Population of District.	No. of Sugar Factories.	Neighbouring large towns.	
						Name.	Population.
35	Garhwal ...	3,602,560	...	429,900	...	...	...
36	Nainital ...	1,701,098	3,686	811,237	...	...	...
37	Lucknow ...	625,280	2,644	793,241	...	Lucknow ...	264,049
38	Undo ...	1,111,385	9,432	976,639	...	...	...
39	Rae-Bareli.	1,121,280	2,738	1,033,761	...	...	...
40	Sitapur ...	1,411,840	30,027	1,175,473	...	Sitapur ...	22,557
41	Hardoi ...	1,463,040	14,423	1,092,834	...	Shahabad ...	20,036
42	Kheri ...	1,895,472	31,652	905,138	...	...	...
43	Fyzabad ...	1,089,875	47,049	1,225,374	...	Fyzabad ...	75,085
44	Gonda ...	1,806,594	22,615	1,403,195	...	...	...
45	Bahraich ...	1,701,354	3,573	1,051,347	...	Bahraich ...	27,804
46	Sultanpur.	1,088,640	20,351	1,083,904	...	...	...
47	Partabgarh.	933,120	11,472	912,843	...	...	...
48	Barabanki.	1,089,964	26,211	1,179,323	...	...	...
	Total ...	68,563,174	1,212,729	46,889,685	2	...	...

The remarks about the situation of the sugar industry in the Bombay Presidency by G. F. Keatinge, Esq., I. C. S., are worth noticing by men of capital and enterprise. "So far as the Bombay Presidency is concerned the sugar industry is concentrated mainly in the Deccan Districts (see page 55). In this locality Gul is generally preferred to refined sugar; and for some years past the average price of Gul has been higher than that of sugar. So long as the public taste remains as it now is and the relative prices of Gul and refined sugar do not greatly change, there is no profit to be made by refining sugar. A reference to the comparative table of yields given on pages 3 to 5 of this paper will show that the yield of cane per acre and the quantity of the cane in the Poona District compare well with the figures of most cane producing countries. Large quantities of manure are used and the cultivation is well conducted. Investigation will no doubt result in raising the yield and quality of the cane; but it is

probable that progress must in the main be looked for in the direction of cheapening production and avoiding waste by means of more efficient implements and appliances: Such improvements are difficult to introduce among peasant cultivators who grow cane on a small scale; but as knowledge is disseminated, credit is organised and enterprise is fostered they will gradually come in. As irrigation increases the area under cane will increase; and with a large area of cane and a higher rate of production per acre a field will be opened to the capitalist if a change in the relative prices of Gul and sugar should make it more profitable to produce refined sugar than raw sugar. The capitalist must be ready to take the field in the Deccan when that time arrives."

3. In Bengal and United Provinces failures have been attributed to want of expert managers. Factory managers must have the experience of actual sugar manufacture and also of other things in general concerned with the factory. This industry requires deep scientific knowledge, and energy and capacity for understanding the work done on cane and cane growing. For this purpose either some properly trained overseers are to be got from outside or some people should be sent from here to undergo training in some big factories abroad. There should be sugar schools of the type of Louisiana State University under the care of these practical and experienced people to spread the technique of growing cane and manufacturing sugar. Germany the most scientifically trained of all the sugar producing countries has long had sugar schools.

In 1901, a sugar factory was started at Formosa by the aid of Governor-General in order to afford an object lesson to the natives. Within ten years the industry at Formosa has made rapid progress and has been taken up by almost all Japanese and foreign enterprise. Agricul-

tural Department has already taken up the work of improvement in cultivation, crushing, boiling, etc., and has even sent a person for training abroad, if it goes a step further it can establish this prosperous sugar-refining industry in important centres.

4. There are many industries in which the principal product does not bring any net profit without the proper utilization of the by-product. So also, the over production of sugar, which has resulted in a crisis, forces every manufacturer of sugar industry to make use of his by-products in other directions.

Very large and well managed factories on the Continent and even in the Colonies are combined with distilleries. Alcohol industry completes the sugar industry. Molasses which is the principal by-product of sugar industry, is converted into Alcohol with the utmost care and use of scientific principles. Alcohol can be produced very cheaply and more so if several neighbouring growers unite to have a common distillery between them. In India the preparation of denatured Alcohol may be allowed, so that it may be used for industrial purposes. This can supply the demand of small engines working at a small fuel cost. It will not only be useful as power raiser for engines, motors, etc. but could also be utilised economically and efficaciously for domestic purposes, such as light and heat. If the planters were to spread the use of denatured Alcohol for such purposes they would, in the near future, have an increasing demand for the by-product of their industry. Then the sugar grower will obtain many advantages both as a consumer and as a producer. As a consumer he will obtain cheaper power; and as a producer he will find a good market for the by-product of his industry, and this will further assist him in his competition against other sugar-producing countries. On

an average there can be obtained from one gallon of waste molasses 0.77 gallon of proof spirit or 0.385 gallon of absolute Alcohol.

It is not only the making of Alcohol which enables these distilleries to pay but also the making of Potash (Carbonate of Potassium) from the last residue after the Alcohol is distilled off. The residue after some treatment is converted into ashes called the "Raw Potash" which contains—

Carbonate of Potassium	50 to 60 per cent.
Chloride of Potassium	5 to 10 "
Sulphate of Potassium about	6 "
Sulphide of Potassium	2 "
Carbonate of Soda	7 "
Silicate matter	10 "
Water	5 "

The sugar manufacturer produces only this raw ashes and sells it to a special chemical works which refine it to eliminate several substances. The yield of "Raw Potash" is 10 per cent. to 12 per cent. of the weight of molasses.

Very small factories which distil molasses will not use the last residue for making "Raw Potash" but use it as fertilizer very extensively and with good results after liming it to correct the excessive acidity. It is specially useful for root crops requiring Potash. Two cwts. of molasses are necessary for making 100 gallons of the residue; and 100 gallons of this residue contain about 4lbs. of Nitrogen and 15 lbs. of Potassium and are worth about Rs. 3. Another industry to which the cane crop is of importance is the manufacture of artificial food for cattle, which is an entirely new industry in India, and is, therefore, worthy of general attention. This is all the more the case from the fact that the question of food is the weak point of Indian cattle and Agriculture. The decline of Indian cattle farming is generally admitted to be chiefly due to the insufficiency and inferior quality of food stuffs.

Molasses is an excellent feeding material. It consists chiefly of hydro-carbons. The albuminoid saving properties of this depend principally on its carbohydrate contents, although it is possible the amides contained in the molasses play a part in cattle-feeding. Carbohydrates are transformed into work and the fertilizing ingredients can be returned to the soil in the excreta of animals. For hard-working draught animals molasses was proved to be an exceedingly wholesome food. Horses which were fed on 5·06 lbs. of molasses, 7·04 lbs. of bran, 7·15 lbs. of maize and hay *ad libitum* were, in spite of the severe work they underwent, in the best condition at the end of the trial of several months. 8·8 lbs. of molasses per 2200 lbs. of live weight were readily taken ; on increasing the quantity to 12·10 lbs. it was found that the condition and capacity of the animal for work were in no way influenced, the only objection to the larger quantity being the sticky condition of the molasses mixture thus produced. Molasses as food for consumption by horses differs considerably in composition from that of cows ; the former should contain more carbohydrates and less protein substance than the other.

Factories in India might use molasses also in making feeding materials for the farmer. On the Continent sugar factories do excellent business in the manufacture of feeding materials. Molascuit (food from molasses) is occupying much attention in America and the Colonies, several thousand tons of which have already been exported to Europe. Large quantities of Russian molasses have been used for this purpose in France and Germany.

Molasses in its raw state has the disadvantage of containing too much liquid and of being incapable of being long preserved ; mixed with other materials, however, it forms the most excellent food. Mixtures of

molasses with ground Cocoaunt, earthnut, linseed, sesamum, maize, bran, chaff, etc., are also wholesome and nutritive when judiciously prepared. The Cellular matter of megass, after the extraction of the juice by the mill, is converted into a spongy mass, capable of absorbing its own volume of liquid. It is preferable to remove all moisture from the megass by heat, after which it is capable of absorbing seven times its weight of molasses, the absorption being facilitated by heating the molasses to a relatively high temperature whereby it is rendered more fluid. By this, not only the water content is diminished but also the danger of deterioration on storing. This food has the appearance of a granular mass, comparatively dry and suitable for transport. By the addition of about 1 per cent. of salt the taste is greatly improved.

Conclusion.

One of the great problems to which the cane-grower should seriously address himself is to secure the production of a cane richer in sugar. Careful and systematic selection of seed, and constant practice of the most favourable system of fertilizing and cultivation will surely result in such an improvement.

Having secured the best development of the cane and established the most favourable conditions of culture the process of manufacture would next receive attention. In central factories the operations can be carried on a large scale and the most economic methods can be employed. With the exception of the manufacture of Gul for domestic use, the small mill and open pan must be abandoned.

Improved methods of clarification are also to be tested, and that process which gives a juice of the greatest purity without too great an expense, brought generally into use. Then it is reasonable to hope that the depression of the sugar industry in India will pass away.

SUGAR INDUSTRY.

BY MUKHTAR SINGH, ESQ.

Pleader, Meerut.

Here I draw a rough sketch of the improvements which can be very easily introduced into India and the advantages derived therefrom will be quite apparent. I know that the scheme is susceptible of further improvement and is already improved in the factory system on a grand scale but I do not urge upon those improvements because they will meet with opposition by the farmers and some of them will require a thorough study of the chemical changes in the sugar production. Besides this I hold that the factory will be a total failure under the present system in India and the time has not arrived for it. The chief difficulty being in the agricultural condition of the people. The agriculturists are too ignorant to know the advantages of uniting together and thus forming a corporation and if any other man takes hold of the factory he is sure to be opposed by them and not being properly supplied with cane he is sure to fail in his efforts. Besides all this there is a great difficulty in transporting cane from one place to another and thus the canes reach the factory after hours from the time when they were cut; this not only evaporates the juice from the canes and not only dries the canes so as to make it difficult to extract juice therefrom but brings about so many chemical changes that the sugar is produced in less quantity and a great deal of crystallisable sugar is converted into molasses. The factory system can only be successful in making sugar from *goor* or jaggery but there has not yet been discovered any method of reconvertng the inverted sugar into crystallized sugar. Owing to the defective boiling a great deal of crystallisable sugar is converted into inverted

sugar in making *goor* and thus there is only a small percentage of crystallisable sugar that can be recovered from *goor* and hence in factories like these unless the manager of the factory and the expert be a calculative man of business there is a very little of hope of its success in the matter.

My system which is not a new one but which is only an improved form of the systems already in vogue in India and in different countries consists of ordinary improvements which can be made in any part of the country and which are described according to and for the different systems separately.

CULTIVATION.

The first and the foremost improvement necessary under all the systems is to select the proper kind of cane. There are hundreds of varieties of canes found all over India and it is not a fit place to enter upon their description here. But however I must suggest that it must be the aim of every sympathiser and well wisher of the Sugar Industry to hit upon the right kind for the locality. It is wrong that any one variety will suit the whole country and also it is wrong that only foreign varieties will be suitable. It is just possible that experiment may prove any variety specially favourable in any part of the country and giving better results than with any of the local varieties but this must be left for the agricultural department and also to those who can spare upon these experiments but for our purpose let the readers see the following points in the varieties already existing in their suburbs. All the varieties of cane be divided into two classes. The thin soft skinned cane and thick hard skinned cane. The first kind is always the best suited for the sugar making as the juice can be expressed more easily and completely. So it becomes almost clear that all these varieties which

have a thin and soft skin are the best. But generally the juice obtained from this variety of cane yields less percentage of sugar than from the latter. The other drawback in the first variety is that the crop is wholly destroyed if it is not irrigated in time. Hundreds of fields sown with this variety become juiceless even if they are attacked by drought only but once and all the further irrigation does not remove this defect. It is why the 2nd variety has come in vogue. In Meerut District, for example, when the rains were sufficient all the fields were sown by a special white variety of cane known by the name of the district *Meeruthi* मेरुठी or *Baddha* बद्धा. This variety is very seldom met with now but it shows its richness in juice and its soft thin skin. Now it is nowhere sown because the successive failures of rains have told that unless there be sufficient means of irrigating the fields it should not be sown and hence its cultivation has given way to another a little thicker and harder variety of white cane known by the name of *घौल Dhaul*. In other places where there is still fear of drought another still harder and thicker variety is sown known by the name of *chin* चिन. I think the same will be the case all over India. This substitution of one variety by another is the strongest sign in favour of the intelligence of our farmers but the introduction is always slow. But still there are other varieties which have crept into, somehow or other, these varieties and no field can be said purely consisting of one variety alone. In Meerut district there is coming one more variety in vogue and it is taking place of *घौल Dhaul*. This variety grows very high and very juicy, the skin is softer and thinner and is known by the name of *Dhotu Surentha* डोतु सुरेंठा. But this variety again does not resist drought so much as the *Dhaul* घौल variety. So in seeking variety it is almost clear that if the means of irrigation be

sufficient only those varieties be sown which are thin soft skinned and if otherwise be the case then the other variety may be substituted. But this other variety is only to be sown under special circumstances and as soon as those circumstances change the variety should also be changed.

The other important factor in its cultivation is seed selection. The upper part of the cane should be chopped off for seed, only from those canes which are healthy and sufficiently strong and when they are taken off from the bed only those should be sown which give a healthy appearance and whose eyes have either sprouted forth or give a strong conviction that they will sprout forth. The two important points are very seldom taken notes of and generally the people sow the seeds got from their own canes however diseased they may be. That is a wrong policy which must be brought home to the cultivators. The soil should be well ploughed in which the cultivators generally do themselves and there is very little necessity of urging this point. Generally only the farm yard manure is applied to the cane fields and this being had in very little quantity does not supply sufficient food for the crop. In foreign countries there are many kinds of manures which are applied to the cane crop but here the cultivators cannot afford to benefit by them. There are good many varieties of manures which are manufactured by Messrs. D. Waldie and Co., Konnagar, Calcutta and they also manufacture specially suited manures for different crops. The analysis given of their products speak favourably but unless anybody gives them a fair trial no definite opinion be expressed here. The only thing worthy of note is that some of my readers may try these manures this year and let the public know of the results whether they repay their costs. The best way of making experiment is that a field of

some one acre, to facilitate experimental expenses, be divided into three parts and one of them be dressed with a farm yard manure with a weighed quantity and the 2nd with a special manure of weighed quantity and in the third nothing be applied. All these three divisions be sown with the same kind of seeds and be irrigated and hold in all at once. The results to be written down in detail. I would have taken this work myself but my profession does not allow me sufficient time to look to these things. However there are very cheap manures which can with advantage be used by the cultivators. The first kind is green manuring *i.e.* pea, hemp, indigo and such other crops are sown in the fields and when they have reached their proper heights and are ready to bring forth their flowers they are ploughed in and irrigated. Thus the whole crop so sown is turned into manure. This is a very cheap manure but as this will require more than a year to bring forth the cane crop people are reluctant to practise it. But when they will follow it they will be convinced of its advantages. The indigo and peas crops are not so well suited for the cane crop as the hemp पत्ती crop. Because the former crops make the canes so high that it gives a very poor percentage of crystallisable sugar. The next important and inexpensive manure I wish to draw attention to is the urine of the cattle. It is a very important article to be used as manure known by the name of night soil. But it is never used in India. The best method of using it in the winter season is to spread the cane straw known as *potti पत्ति* where the cattle live over night so that the cattle may pass their nights comfortably. These leaves will be well saturated with the urine of the cattle and these may be taken off and new substituted in their places. Thus every day there will be a fresh supply of manure. In the hot season cane leaves cannot be had and so the

sand may be spread underneath and every day a new thin layer substituted. If this be tried for the whole year there will be no necessity of bringing the special manures from any Company.

The next important point in cultivation is the hoeing of the cane crop. Few years back the cane crop was hoed in perfectly well but now the cultivators of those places at least where the irrigation is effected by canals do not pay much attention to it and take its work by applying more water to the crop. This does not only serve the required purpose but at the same time weakens the crops. It is all due, I think, to the fact that the people do not remember the purpose which it served. It will not be out of place if I write a few words here to explain its object. In our province cane is cultivated in the last months of winter season, *i.e.* in Phalgun and Chaitra and its infancy passes in the summer season. The hot air of the summer season tells against this crop very badly and thus it stands in need of constant watering. In order to obviate this hoeing is practised. The earth around the plant is pulverised and made into a very fine powder so that the plant may go deep down into the earth to search for moisture and thus may resist the drought. There is one more important point in connection with the same that the earth being pulverised there is sufficient food available for the nourishment of the plant. Now on the other hand if the crop be not hoed at all or not hoed perfectly well the crop will not resist the drought and if the rain fails or the canal water is not available in time the whole crop will go to the dogs and there will be very little food available for the plant. The only food assimilated by the plants is the dissolved earth in water. If the earth is not pulverised the plant will search in vain for food and will die its premature death. People hoe the cane fields because

of their scruples for doing so and I have seen them hoeing at places where there is no plant at all while leaving un-hoed the places which are full of cane plants. A man of ordinary strength could hoe but 1/10 of an acre in the whole day a few years back but now though the people are weaker but they can hoe twice the same showing their half-heartedness in the work. I would ask my readers to pay special attention to this branch of cultivation and let them see for themselves that a little expense means a high outturn.

Generally the cane crop is attacked by many diseases; to treat them all here is simply impossible and out of place. Leaving this for some other time to come let me bring home to my readers that hoeing and watering in time is the best remedy for them all. I have tried with success these two remedies in many a cases; I have found them successful. At least as far as the infant state of the canes is concerned the causes to all the diseases can be traced either to the defective hoeing and watering or to some defect in the seed. This being so I wish that my readers will devote special attention towards this point of hoeing.

Excessive watering does but seldom injury to the cane fields but still it weakens the plants in general and make them susceptible of dying soon by the drought; This is generally practised in places where the fields are irrigated by canal. Just as a man who makes himself accustomed of eating rich food is easily effected by small difficulties so is the case with plants if you make them accustomed of using more water they will not hold their own against the draughts which are so very common in rainy season when the canal water is but seldom supplied.

EXTRACTION OF JUICE.

Before giving a few suggestions for extracting the cane juice let me observe as to the proper time of cutting

the canes. As soon as the rainy season is over the canes stop growing and they begin to ripe. But after the rainy season the old stock of *goor* and *shakkar*, i.e., the different forms of native sugars is almost destroyed by moisture and thus it begins to sell very high. People wish to take advantage of the high prices and they begin to extract juice out of them. This gives a very poor yield but as the prices are very high it still pays well. As far as the making of the native sugars is concerned it is not of greater importance that the canes be properly ripe no doubt if they are ripe they will give better stiff and greater yield but then the prices will go down so there is nothing objectionable in this practice but if this *goor* or Jaggery is meant for making crystallised sugar or *rah* is prepared for preparing refined sugar it will be a total failure as the percentage of crystals will be very low and will not pay even the labour and money invested. The canes should be cut only then and then for refined sugar when the canes have stopped growing and the upper end of leaves become a little yellowish rather than green. There is also one point worth considering that the canes if left to the time when frost visits and effects all the crops including the cane crop they should be well watered as the frost tells very badly against the cane crop.

The juice becomes dried, gives a bad smell while boiling and the crystals become very much lessened. In India the sprouting of buds or flowers in a cane crop is looked upon as very bad omen and it is true that it is so not because it brings about those calamities which the people fear of but because after budding the whole juice is dried and thus nothing can be obtained from this crop.

Observing few remarks upon the time of cutting I wish to say a few words as to the extraction of juice. Cane consists of hard joints which are brittle in many

cases and break off by a small pressure in several varieties of canes. These joints are found at the intervals varying from one foot to 3 inches in length. Between joints there are the juice cells covered by a hard skin. These juice cells are of spongy nature and very soft. If they are passed they give out the juice and if left again in the juice they imbibe the same in. The varieties of brittle joints give a great deal of trouble in extracting the juice as they are with difficulty fed in the rollers mills. This defect exists in the *chin* चिन variety adverted to above.

There are two varieties of roller mills one is horizontal and the other is vertical. The rollers are both made of iron and of wood. As there is nowhere old kind of mills in vogue I do not wish to enter into their description here. The wood rollers are not so efficient in extracting the juice as the iron ones. Unfortunately Indians copy out every thing as soon as they see one thing to pay without considering the principles involved therein. The iron rollers mills began to be manufactured as soon as they were invented but there are very few foundries in India which know how to make them. Generally to cheapen their products they try to use cheap stuff and pay very little attention towards their efficiency. I have a design of my own for these machines and as long as one is not made after it I cannot publish the same but however a few remarks here will not see out of place. In both kinds of mills, whether they be horizontal or vertical, the surfaces of the iron be made of such a stuff as it may remain always rough to the touch. By having it made rough the upper part of the skin will be smashed and the inner part will be presented to the other rollers and thus the whole juice will be expressed. This is very easily done if the crystals of iron be thicker while moulding or while moulding if the moulds be surrounded with water so that they may

become cold very soon. There are other methods too but they being a little too expensive I do not give them here. If the rollers be made by the latter process I am sure that the juice expressed will be much more than it is expressed by the ordinary rollers. The only objection that can be raised against this product is that its planing is very difficult but if the iron (steel) used for the cutting instrument be properly and well made this difficulty can be removed and if it be a little more expensive it will repay in making this mill popular. The other method in order to get such a product I have hit upon is that Corundum powder be mixed with iron in small quantity before moulding. But I cannot say whether this will meet with success. I wish that there be made successive trials to obtain these results by the foundry managers and let this be one of the famous quality found in their rollers. I have asked a friend of mine who is a factory manager to try these experiments and shall let the readers know the result as soon as possible.

It is estimated that the best three roller mills in India extract but only 67 per cent. of the juice and thus 33 per cent. of the juice is left in the begass. This is a very high percentage of loss incurred daily in our factories. To use the Engine driven mills is an impossibility in India and as far as my calculation is concerned, their introduction is not yet cheap enough to pay their cost of working. The other system which is gaining much favour in foreign countries, *i.e.*, extracting juice by means of water (steeping system as it is known) cannot be tried with success in India at present, unless exhaust steam from large factories be available to evaporate the excess of water. The rate of fuel has so enormously increased that it is very difficult to work the system successfully. But still where there be cheap fuel available or exhaust steam at hand they may try the system experimentally.

When the whole juice is expressed by the roller mills, the begass should be steeped in hot water for a few minutes and again squeezed either by means of the roller mill or by ordinary wooden press. This will give an extra outturn and if nothing is spent upon evaporating it or a little amount only it must pay well. There are two roller mills in several parts of the country in vogue, still they should left off very soon and three roller mills of the material which gives a rough surface be used. If four roller mills be introduced they must give a higher percentage of juice. But in order to use a four roller mill the following instructions will be of importance. The four rollers should be divided into two separate sets of two rollers each. The front set rollers should be lined circumference wise all through at a distance of $\frac{1}{5}$ th of an inch. These lines must be obtruding with a sharp blade. The furrows should not be very deep ; the depth should not be more than $\frac{1}{20}$ of an inch. These rollers will take the canes and will split them into small shreds. The last two rollers must be of a larger size and smooth joined together. The back rollers will squeeze out the whole juice and there will be no chance of imbibing the juice again. If the skin be properly broken into, the juice will easily come out and the whole force of the rollers be applied to the spongy portion of the canes and thus the juice cells will be completely destroyed. If these furrows be difficult to be made the front rollers while being planned be finished with a saw-like serrated instrument. If this too be difficult the front rollers be dug through like the mill stones at very small intervals so that the whole skin of the canes be perforated while passing through these rollers. This will make the extraction of the juice easier and complete. These four roller mills if properly constructed will be driven by two bullocks as well, The carrier between the two sets

must be very skilfully made so that the canes passing from the front rollers be at once seized by the back rollers. There is very little chance of its difficult driving by ordinary two bullocks, the reason being that in three roller mills the cane is crushed twice and it will also be crushed twice in the four roller mills.

However, if the readers be reluctant to use four roller mills or such a mill be not easily available let them use three roller mills whose three rollers are made of the material adverted to above or if such rollers are not available let the whole surface of the rollers be studded so to say with five obtruding points so that the skin be perfectly penetrated through. The principle underlying my whole subject is that to take out good amount of cane juice is simply impossible, if the outer skin of the canes be not properly split up as when the canes are pressed by the rollers they give way to juice at only one or two places and the way thus made is not at all sufficient to pass out the whole juice they contain and as the rollers very soon leave these canes so they imbibe again a small quantity of juice. There is also another ground, *viz.*, the skin resists the force that must be applied to the spongy pith under the skin. That is the bark of the canes is an impediment both to let the juice out and also to be pressed by the force applied. To make it clear if you take a very soft thing and surround it with a sheet of a hard substance and then press the same the pressure applied directly to the soft thing will be very small as a good deal of it will be lost by the resistance offered by the sheet with which it is surrounded. To take another illustration to illustrate the other grounds: if a sponge full of water be surrounded with a water-proof cloth and only a small aperture be left to let the water pass the sponge being squeezed for a

while will not let go the whole water. But if the same hole be made wider more water will go out by the same amount of pressure. So without increasing the pressure we can get more water out of this sponge by increasing the width of the same hole or by increasing the number of holes on the waterproof cloth. Similarly the more quantity of juice will be available by the same force if the bark of the cane be perfectly perforated all around. Do this in any of the ways I have pointed out above or think of some better method to achieve the same end. I know that there are more practical and thinking men in the field than myself and so I have stated the principles I wish to be worked out. I shall be too glad to hear better suggestions from my readers and to improve upon them if possible.

There are some defects more generally met with in these mills which should be pointed out here. The first and the foremost is that the oil cups and adjusting screws and antifriction bearings are very crude and defective. The bearings are generally made of lead, zinc and copper but they are very hard and do not serve the purpose well. I beseech my foundry readers to use the best metal possible for the same though the price be a little high, because by supplying good bearings the force applied will be less and thus the mills will be worked with a very little space between the two rollers which will mean a high pressure with the same force. The force lost by friction will be thus utilized. The adjusting screws if properly made, will not easily leave their place and will remain fit where they are once adjusted and this will not trouble the poor farmers. The oil cups are generally made very shallow and they cannot hold sufficient oil for the same and thus not only the cylindrical portion of the

roller चाम् is easily destroyed but a great deal of force is lost in friction. The oil generally used is the sesame oil, which being a little gummy jams the bearing and thus power is lost in friction. If a little vaseline with graphite be used for the purpose, it will prove highly beneficial. This not being a very costly article, people will at once begin to use it, if this be supplied by the same mill maker, to their clients at a nominal profit. Where the hire system is in vogue, the managers must look to this important fact, as by looking to it, they will be able to use the same mill for a few seasons more and the smooth working of the mill be well approved of by the farmers. Besides these defects, there are some minor defects met with in these mills. The sheet, underneath which the juice passes out is very defectively made inasmuch as the juice trickles down through the small openings where these rollers are fitted in. This trickling makes the foundation of the mill shake and thus a greater force is necessary to work the mill, half of the force being lost in friction. Small lengthwise lines be dug into the rollers at a distance of half an inch so that the canes be properly fed in. The scrapers should be well fixed in their proper position so that the rollers be not coated over with the begass. The apperture at the back of the rollers should be well shut off so as not to allow the crushed cane pass without being expressed a second time. There are so many points that must be attended to that it will take many pages to enumerate them all in detail but the most important of them have been pointed out above and it will suffice for the present. The mill must go on easily and smoothly that is the only aim of the makers of the mill, no force being wasted in the friction produced by defective manufacture of the mill.

The canes should not be allowed to lie uncrushed

for a long time but they should be crushed as soon as cut, as leaving them for a time will make the bark harder and the juice to evaporate. Besides this, it will bring about several chemical changes which will be very injurious to the percentage of sugar produced by the juice obtained from these canes. The use of an earthen vessel dug into the earth for receiving the juice is defective owing to several causes. A few of them are give below :—

1. The earthen vessel being dug up into the earth cannot be properly cleansed every day.

2. The cane juice being acid fermentation sets in quickly in the earthen vessel and this when boiled turns a good deal of crystallisable sugar into inverted sugar.

3. The earthen vessel cannot be emptied easily. Time and labour are thus uselessly spent thereon.

4. The earth around the earthen vessel becomes moist and thus the foundation of the mill is shaken and thus force is lost in friction.

5. The juice remains for a very long time in the vessel and thus it remains cold for a few hours before it is put on fire which gives a favourable chance of fermentation.

6. The earthen vessel is also very costly.

7. If this vessel is broken by chance there is a great difficulty in taking it out and putting another in its stead.

In order to get over these inconveniences and defects, at some places three big vessels with handles made of ropes are employed and when one of them is filled up the second is put in its place and then again the third. Thus two men can (lift) this vessel very easily. It saves time and labour and can be daily cleansed. Mr. Hadi has

suggested the use of tin canisters which is a very good suggestion as they can be had everywhere. So where the three vessel system is not in vogue tin canisters may be used with advantage.

The cane juice should be boiled as soon as it comes out of the canes and should not be allowed to stand unnecessarily long.

BOILING.

This is the most important process in sugar making and more attention should be paid towards it. There are several systems already in vogue and to criticise all will be very lengthy. I have a mind to give out my own design of boiling as it is cheap and effective but as I have not made a trial of it, I withhold the same for a reason or two. However now I wish to suggest a few improvements in the different systems already in vogue. I hold that there is very little difference between the one pan, two pans, five or six pans (*bel* system as it is technically called) and Mr. Hadi's system of boiling. The difference is due to the skill employed and the juice treated and to no mechanical excellence of the one over the other. It will be better if I take the above systems one by one and deal thereunder their defects and remedies and in the last to enumerate a few suggestions that I think will be useful for every boiler.

For a long time I have been in correspondence with Khan Bahadur S. M. Hadi and also have written articles pointing out the defects in his process. The readers who receive "Leader" might have seen the articles and also the answers given by Mr. Shabhis Husain of Amroha. Those who wish to make a thorough study of Mr. Hadi's process may look to the back numbers of the "Leader" and read for themselves the controversy

published therein. I need not here repeat it, but give only a few points to clear my suggestions.

ONE PAN BOILING.

For the most part in the whole of India one pan is employed to boil the cane juice. It is specially so where any form of jaggery is made and the cane juice is not boiled for crystallised sugar. The old pans are made of about hundred pieces of iron some 6 in. radius studded and rivetted together. These pans are still in vogue at different places and so a few remarks upon them will not be out of place here. This rivetting together of so many pieces entails a great amount of labour, time and money besides this all the juice is not boiled therein properly. There are small cavities left around each piece of iron and the thick syrup or massacuits (*zab*) when taken from these pans is filled up in these cavities and with all the necessary precautions being taken it cannot be taken out of the pan fully. Thus there is a loss of some one pound in each charge. This is not the only thing objectionable but this massacuits is mixed up with the new juice and thus was boiled again with the fresh discharge and so on thus imparting a colour to it. You know that all the wines are coloured with caramel which is only a form of burnt sugar. In centrifuging these massacuits it was found very difficult to get rid of this colouring matter and to get good white crystallised sugar was an impossibility. There was also one more defect, *viz.*, it could not be properly cleansed every day and at least when the boiling was stopped each day or every third or fourth day with all the skill of the boiler this material was charred in the pans. This defect has been well removed in the cast iron pans which is all one piece throughout. These pans are

being introduced but very slowly. The chief reason of their slow progress is that the dealers in the old pans do not wish to suffer a heavy loss and they are substituting these old ones with this new type. This is a healthy change, of course, and in our district at least farmers insist upon having them rather than the old ones. Where these pans have not yet been introduced, I beseech my readers to open an agency on hire system and let these new pans be introduced. This will make a wonderful change in the whole system at no cost to the farmers, as the rent for the old and the new one is the same; not only are they free from the defects adverted to above but the pans are thicker than the old ones and thus give better results than the former ones.

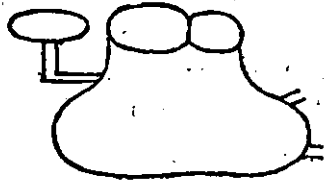
Then there is one more point necessary to be taken note of. The furnaces are generally quite straight and deep. This requires a great deal of fuel than necessary and also takes greater time in boiling. The cane juice is stored for a long time before it can be poured into the pan. If the juice takes more time in boiling, the chemical changes will be more injurious to the percentage of crystals. Thus it should be managed that the time taken for boiling should be the shortest. This defect can be very easily removed if the furnace be made wider in the sides at the bottom as illustrated in the margin.

The furnace should not be very deep. The fuel feeding hole must be as small as possible and the smoke flue be steepy rather than straight and be placed so that the smoke may not spread



itself in the boiling chamber and thus spoil the whole stuff making it smoky and dusty. The system of iron chimney is a very good introduction in Mr. Hadi's system but people shy of its use. But if the readers can experiment themselves they may make a chimney of clay or of iron, the former being cheaper and easily procurable. If there be two holes instead of one and iron bars be used for the ash pit it will be a further improvement as illustrated in the margin.

This will take more air and thus the fire will burn more briskly and the fuel be used in a better way. These iron bars should be well dabbed up with fire clay so that they may last longer.



There is one defect in this system which requires the juice to be kept up for a long time. This defect can be easily removed, if one more pan is kept at only water boiling point and a pipe of bamboo connected with the cane mill over here straining the cane juice by an adjusted strainer at the cane mill and this pan (reservoir). Thus the juice will not be kept for a single minute un-boiled and the fermentation will be as little as possible. You know that the cane juice if put for a long time will turn sour and if kept for a longer time still it will become vinegar. This is very injurious to the crystallisation of the sugar and should be avoided as far as possible. This has been taken note of by Mr. Hadi and he has placed a reservoir in the beginning but the above system of a bamboo pipe will be an improvement in his system,

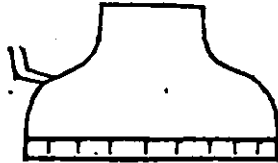
In this system there are two things special to note. First the pan is quite sufficient for one cane mill driven by two bullocks and thus one should not worry about the co-operation of the proprietors of the different other mills as is necessary in the bell system and Mr. Hadi's system. I do not mean by pointing out this advantage that the Indians should not co-operative and join together but we cannot shut our eyes to the existing state of things and it is no use ignoring them. Mr. Hadi's bet met with a total failure in our district and even those who tried to work it experimentally though assisted by officials, were unsuccessful to establish one because the people do not agree to work at one place, so this system has this advantage. May God remove this barrier soon. Secondly the fire can be stopped and increased at the sweet will of the boiler and thus it can be better controlled.

TWO PANS BOILING SYSTEM.

In a few districts in our province for one cane mill two pans are employed. It is practised only in those places where one cane mill is owned by some 18 men and each of them has two bullocks of his own to be driven by turns. As each pair has to work only once a day for a very short time, it is driven very fast and thus the cane juice got is in very large quantity. In order to facilitate the boiling, two pans are employed and as the work done is a little more than the one pan would have done two pans prove quite sufficient for the task. These pans are generally of the old type as described above under the one pan boiling system. So these pans too must be substituted by the new designed pans consisting of one

piece all through. This is a very necessary improvement. These two pans are very irregularly employed. At times the scum is taken in the first and at others it is taken in the second and so on. There is no definite time fixed when the one pan will be emptied into the second and the second into the storer. This irregularity often tells highly against the crystallisation of the sugar. This irregularity cannot be easily removed as who knows when massacuits be ready to be taken off from the second and when the earthen jar be filled up for the first. As long as these two things cannot be definite which they, under the circumstances, will never be, so there must be some other method to cure this defect. There is also one other objection that the fire cannot be controlled without becoming detrimental to the skimming operation, *i.e.*, if the fire be stopped the defecation in the first pan will suffer. These two defects are very difficult to cure. There is only one method and one only and it is to have the pans of wider and shallower dimensions and to increase the dimensions of the earthen jars accordingly and thus to use the first pan as a reservoir and the second as an evaporator and boiler. If the same bamboo pipe be made use of as stated in the one pan boiling system, it will prove useful and to make the furnace better so that the fire may be more brisk and the evaporation be completed in a shorter time. There may also be mentioned another improvement which is also very easy to be introduced that a third small vessel be employed and this third vessel be put by cutting a small aperture in the furnace and at a small distance from the main surface so that the direct heat may not be applied under this pan and this pan will remain at a water boiling point only. To illustrate the same we give below the rough sketch of furnace of this sort.

Thus after the froth has subsided in the 2nd pan and the juice has become a little thick of a consistency of syrup it may be put into the third pan to boil to the thread point. The first pan may be used as reservoir. This arrangement will not necessitate the stopping of fire and the fire may be allowed to burn without fear of charring the sugar.



BEL SYSTEM.

In the bel system several pans are employed for this purpose and the last pan wherein the cane juice is ready for potting is placed just near the place where the fireman sits. There the fire being the lowest, there is no chance of spoiling the sugar. These pans are of the old type and such small pans are not yet manufactured of one piece only. Where sweet-meat maker's like pans are employed, they are free from the defect pointed out in the one pan system. But if several pieces pans are employed they must be discontinued very soon. I would ask my readers to manufacture pans for the bel system on the same lines on which these new pans are manufactured. Besides this the bel system requires a few mills working side by side and thus they have to put up their juice in some cases for hours together before boiling. If the juice be not available in sufficient quantity it is better that the one pan system with a reservoir pan be employed. These

pans are deeper than the ordinary pans in several cases and thus the heating surface is less than it ought to be. If shallower vessels of wider dimensions be employed for the purpose it will prove more beneficial. *The cane juice should not be stocked for boiling and if it be found unavoidable it should be kept hot.* The first vessel should be used as reservoir and special attention should be paid to the last vessel so that the heat applied be very little in no way more than the boiling point of water. The other precautions are the same as in the other systems described above. This system economises the expense of time and labour and if properly conducted according to the above directions it will prove as beneficial and useful as that of Mr. Hadi's system.

HADI'S SYSTEM.

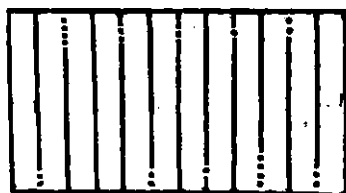
This requires more minute and close study not because it is not so very useful but because it comes from an authority no less than an Assistant Director of the Agricultural Department. I am sorry to observe here that when I began criticising Mr. Hadi's process, I never meant an offence to him but his admirers took it to be so. I think Mr. Hadi to be a hard working man and a man really interested in the sugar industry no matter if according to my convictions his invention of boiling pan is in no way better than the existing systems. I think we, who are interested in the well-being of Indian industries, are all working in the same field sincerely and if we criticise and are criticised with an eye to get at the truth, we should not be offended but we should reply with reasons if the objections are wrong and admit the defects if they are true. We, poor and backward, Indians have no time to waste in useless talks which may result in

enmity and bad feelings. I, again before giving out my objections against his system request Khan Bahadur S. M. Hadi's admirers and his kind self to look upon me as a co-worker in the field and to think that what I say or write is only with the idea of getting at the truth and to improve upon the system. The first objection against Mr. Hadi's system is that it does not suit the circumstances of the country; at least it cannot be easily planted in those places where the people do not combine and open a few cane mills together. Secondly, the product is in no way superior to the one pan, two pan and bel system product. Thirdly, the pans are very costly and cannot be bought by poor farmers. Fourthly, the pans being very thin there is a fear of caramelising the sugar in boiling. Fifthly, the last pans are placed at such a place that the heat cannot be easily controlled. Sixthly, the working expenses of the pans are very high. No doubt the calculation given comparatively show that the working is cheaper but it is simply misleading as the readers of my articles in "Leader" will bear out. The fact is that the salaries paid to so many supervisors and other workers are paid by the Department and they are not shown in the working expenses and the expenses of the old system are shown at a very high scale. Seventhly, the furnace is defective inasmuch as the fuels other than the cane leaves are necessary to boil the juice while in the old system nothing else but only the cane leaves suffice.

With due deference to him and to his admirers, I suggest the following improvements :—

The reservoir and the defecators be made of iron and shallower than they are made now. They must be more than double in dimensions so that the scum be more

easily removed and a greater surface be exposed to fire and thus there will be a saving in fuel. The estimates given in his book show that he requires extra fuel to burn underneath his pans besides the cane leaves and begass while in all the Indian methods no extra fuel is necessary. This must be due to this as well as the defect in his furnace. The last pan should not be reserved for making the massacuits (*rah*) but another small aperture be made as suggested in the two pans system and over which the syrupy juice as soon as the froth subsides be taken to this new pan and be made of the consistency of *rah*. This will remove the chance of overheating the product and even if the fireman be not an expert will give a good produce. The last compartment is made on no principle. The principle involved in the foreign pans of this sort is quite separate and has not even been thought of in its manufacture. Let me explain the principle and the construction of these pans.



The illustration is a rough sketch of the foreign pans. Each of these walls which terminates by the same sheet of iron is only $\frac{1}{4}$

less than this height at the place dotted in the diagram. This vessel or pan is placed at a little inclination so that there may be a natural flow of juice from one end to the other. In foreign countries lime and other chemicals are used and these chemicals do not come out over the surface of the juice in scum and so it is quite necessary to separate the small particles of scum floating in the juice which "make the juice hazy" if lime be used. When the juice goes from one corner to another it leaves off the scum in each compartment. In travelling so long a dis-

tance these small particles settle upon the surface. These ends can be easily removed altogether at the time of cleansing. In some of the pans these walls are removable and can be fitted whenever and wherever necessary according to the juice treated. This is the only object which has obliged the foreigners to invent such a complicated vessel. But this is of no use in Mr. Hadi's plant. As the pan employed is only used when the scum is almost taken off the juice is ready for the "frothing" state. When the juice has become boiled and is frothy these mechanical devices are of no avail; because then the scummy particles are so intermixed with the juice that fire and their striky state will not allow them to settle down. So if the above vessel, *i.e.*, an oblong vessel without compartments and this last vessel be interchanged there will be effected an improvement. The other thing of note is to use the iron sheet vessels instead of the copper and brass ones as the latter are more costly and cannot be used by the ordinary landlords. If they become rusty in rainy season some antirust polish be used for the purpose and they may be kept up in a dry place.

If the reservoir be connected with the mills by means of iron or bamboo pipes it may be an improvement.

GENERAL SUGGESTIONS.

I have already pointed out that the cane juice should be boiled as soon as it is available from the mills. Lime water in a small quantity should be used in each case. If the juice be of poor quality and the crystals be very small a small amount of मसजी & साजबामश्री (Masajee and Sajabhamasree) water be used after taking off the scum. This will increase very much the power of crystallisation and unite the small crystals with big ones. Crude potash sajji be used in small quantity. The test of knowing

whether sufficient defecation has been effected is that the color of the scum be quite white. Do not use soda-bi-carb for defecating purposes. The *rāh* prepared should be as thin as is prepared by Mr. Hadi. His *rāh* is the best suited for the centrifugal not because it is clarified in the best possible way but being thin enough the machine easily separates the crystals from molasses. Moreover if the *rāh* be thick the molasses will not leave the crystals and more time will be wasted in centrifugaling the machine. If you have made *rāh* thick, use more molasses before centrifugaling the same. I have seen that *rāh* prepared thick does not easily leave the crystals and the crystals are not as thick as in a thin *rāh*. The thick *rāh* system has been introduced from the time when the *rāh* was taken on contract system. The farmers make a contract with the *khandsaris* to supply the *rāh* at a contracted rate for a month or for the whole season. They leave their own boiler with every cane mill and thus this boiler wishes to get as much as possible of crystals and thus tries to get thick *rāh* so that the molasses may be in less quantity. But it is a very wrong policy and it is much more so with those who wish to use centrifugals. For *khandsari's* too who make use of the old system the process is injurious as the thick *rāh* takes much more time to separate the molasses and more *Sirmal* is necessary.

There are many other chemicals which can be made use of with advantage already known in India but I do not wish to enter here upon their respective merits in detail. I come now to the centrifugal or the separation of the crystals from molasses.

CRYSTAL SEPARATIONS.

There are two separate well known systems already in vogue one is the old Indian system and the other the

foreign system. It was my firm conviction a few years back that centrifugals are the thing which must be introduced to regenerate the sugar industry but my belief was shaken a few months back by a friend of mine who has lately taken to the sugar business by the old method. He has informed me that my calculations were wrong and the expenses are not so much in the old system as they are given to be. However I have asked him to use a centrifugal machine himself and to see side by side which is cheaper and why? So I am not now prepared to express a definite opinion upon the same. However as I have only studied the centrifugal system, I give a few instructions as to its more practicability.

1. The molasses should be mixed with the *rah* and should be made very thin so that it may easily pass off the wire gauze.

2. Soda-bi-carb should not be mixed with this mixture as the crystals are injured by it.

3. Always drop the mixture in the cage when the machine be in motion by and by. I have seen people dropping it all at once in the cage and then they put the machine in motion. This makes the whole machine shake and sometimes it seems that the machine will go asunder and the foundation be shaken. In order to remove this defect two bamboos are employed and two men put the machine in the right place. This also makes the engine to stop and much more power than necessary is required. But if the mixture be dropped when the machine is in motion this defect is easily removed.

4. If you have not got the machine buy always power driven machines which may have a steam purging arrangement. If dry steam-apparatus be fixed to these machines it will be still better.

5. Wash always with pure water and if necessary use

a little indigo and milk so that the whiteness be artificial and the product be liked by the market. But in using indigo take care that the same be used in the smallest quantity possible only to tinge very lightly the produce. Otherwise the color will look smuggy and very defective. In European countries they use ultramarine blue for this purpose.

6. Crush all the small lumps of crystals in the *rah* otherwise these lumps will not be devoid of molasses and will remain as they were and also on the other hand the upper and lower layers of these lumps be coloured with molasses.

7. Do not run out the whole molasses but let a little molass be left in the crystals not so much as to give it reddish appearance but only so much as to please the Indian taste. Indians use sugar which is more sweet than the foreign sugar and this is only because in Indian sugar a little molasses is left while in the foreigner's sugar the whole is run out. This will be more readily sold in the market than the purest and the whitest sugar. Moreover people do not call it foreign but believe it to be Indian and thus there will be no resistance offered in the market in selling it.

8. When you are required to use the *rah* made ordinarily in the villages centrifugal it and mash and purge with steam to make it white and if you find that owing to the defective boiling you cannot separate the molasses all through centrifugal but partially for a very little time and use *sirmal* for a few days and the product will become quite marketable. But on the other hand if you make your own *rah* go on taking scum up to the last using lime, *Bhindi water* and Sajji and take off the stuff when it is thin just like Mr. Hadi's *rab* and you will have no chance of complaint. If you still find it

difficult to get good white sugar from the bazar, make very thin syrup of it wash the sugar in the machine cage with this syrup until it has become white.

9. Never use the *Munja grass* brush for washing the sugar in the cage, as however a man expert may be it is difficult for him to use the water homogeneously all over the surface of the drum. For this purpose the makers of the machines have designed an apparatus known by the name of "Syringe." It has a round nozzle at the end which contains very small holes and by holding it from the bottom up to the top the whole cage can be very easily washed out. This requires very little skill and an ordinary man after trying a few times can be successful in the same. I do not know why Khan Bahadur S. M. Hadi is so highly against it and always uses the brush instead of syringe. Perhaps it may be due to the fact that more water passes through it than necessary and thus a very high percentage of sugar is washed off by the use of syringe but this can be very easily remedied by selecting a syringe of thinner holes than it is used in foreign countries.

10. Always wash with steam or warm water the wire gauze so that the holes be quite clear and the molasses may pass easily out of these holes.

11. Make a free use of break and spring arrangement in these machines to stop the motion of the machines when necessary. As it happens that by some irregularity the machine does not work smoothly if such be the case stop it and again put the machine in motion when every thing has turned aright.

12. Use two vessels for the molasses, *i.e.*, there must be two quite separate stores for the molasses. The one

must contain the molasses that come out in the beginning in rush and the other should contain when it goes out only in a thin stream. The last kind of molasses is whiter and richer in crystals ; it is not only useful in boiling the molasses again but it will also be sold at a much higher rate and will repay your worry. This is not the only purpose which it serves but there is very important point worth noting, *i.e.*, if this molasses which has run in a thin stream be mixed with the *rah* in order to thin it the product may be whiter still and the colouring principle which has left off the first charge of the *rah* may not spoil the second charge. This precaution when practised will prove highly beneficial.

With these few words, I beg leave of the readers for the present. I shall be highly obliged if any of my readers will criticise my defects in the above suggestions and will admit their truth if any with thanks. I shall be too glad to solve the practical difficulties that may be found in the ways of my readers who may care to make experiments. I beg to offer my thanks to The Hon'ble Mr. R. N. Mudholker, the General Secretary of Industrial Conference, Amraoti who has given me a chance of publishing my views upon the subject.

In the end I pray to Almighty God to grant us sufficient means, courage and knowledge to regenerate our backward industries and to put us on the right path.

LAC CULTIVATION.

BY TRIMBAK RAMCHANDRA KOTWAL, ESQ., B. A., LL. B.,
Subordinate Judge, Talegaon, Poona District.

The object of this paper is to describe shortly the various stages in the life of the lac insect, to note the distribution of the insect in the Bombay Presidency, to consider the measures by which its cultivation may be introduced and increased in India, to note the improved methods of its collection, to ascertain its potentialities as an article of commerce and to point out how far it can be made to bring revenue to Government and additional income to the rayat.

Lac —Lac is a resinous incrustation excreted by a scale insect. Its mouth consists of a sucking apparatus combined with a pointed lancet. With this latter, the insect pierces the bark of the twig of the tree and then inserts the sucking tube and draws up the sap from the succulent inner bark. It may be likened to an animated siphon. The exudation given out at the anal end solidifies on contact with the air, and this is the way in which lac is formed. The insects live and feed gregariously closely packed together on one twig, hence the lac produces a continuous incrustation on the twigs which when collected is called *stick lac*. When manufactured it becomes *shellac*. The *dyelac* consists for the most part of the material from which eggs are developed in the body of the female insect. The synthetic dyes have driven this natural colouring matter out of the market, reduced the price of lac, and checked its production. New demands for lac are expected to stimulate the production again and electric works and gramophones are likely to increase this demand. A new process of refining crude lac discovered by Mr. Puran Singh is expected to renovate the lac industry.

The above description raises all the points I propose to discuss. What is the life history of the insect? What is its food and where can it be found? How can the insect and its food-supply be increased? Can we make the natural processes of lac production yield larger out-turns? What steps should owners of land, (on which the suitable trees grow) take to increase their income? What trees will supply lac producing raw material to nature's living factory? What are the commercial and industrial uses of lac and its products?

The question of lac production is a branch of Economic Entomology. In the words of the entomologist of the Baroda State, "The present day activities of Economic Entomology in India are encouraging. Economic Entomology is an endeavour to control all insect activities that affect the welfare of man either beneficially or harmfully. It is an applied science, an adaptation of pure Entomology to the ends of agriculture and commerce." Hence the experiments of domesticating honey-bees and cultivating lac on the unproductive trees in agricultural areas, deserve due attention. The latter has already proved successful and efforts are being made to attract to it the attention of the cultivators.

It seems to me a remarkably interesting and glorious occupation to join one's own skill and intelligence to nature's generous and beneficent agencies and to become though in a limited sense, a creator of improved types or species both in the vegetable and the animal kingdoms.

*Description and life history of the lac insect and what the scientific study of the subject means ;—*Lac insect belongs to that class of insects which have no metamorphosis but pass through only the egg, larva and imago stages. They are herbivorous and not carnivorous. We have, therefore, to gain a knowledge of their habits as

to where they live, when they may be expected to appear, what they live upon, and to investigate the laws of their increase and the conditions under which they thrive, the sources of adequate supply of their natural food, the enemies of the insects, the attitude of the cultivator towards them and such other points. This, I understand, is the scientific method of the study of the economic insect *lac*. The newly hatched insect or larva is a minute red or orange coloured insect, elliptical in shape, $\frac{1}{40}$ th of an inch in length; males and females cannot be distinguished at this stage. The female when about $2\frac{1}{2}$ months old, is impregnated by the male. She continues to grow in size and exudes the lac incrustation for another $2\frac{1}{2}$ months. The ovary becomes greatly enlarged and is filled with a bright red fluid. During the last month of the life, eggs are gradually formed about a thousand in each female from this fluid. This is the colouring matter. White tufts protrude from the female anal and the breathing openings. The presence of white tufts is a sign of health. The male when about $2\frac{1}{2}$ months old crawls over the incrustations formed by the female. The male larvae as is the case with the female after a short period of activity after first hatching come to rest on the twig and bury their proboscis in it.

The life history differs according to the degrees of heat or moisture or both. The insect generally passes through two stages in the year, rarely a third. The periods at which the young larvae are seen to swarm also vary according to locality but usually in the first week of July and again in December or January. The larvae do not all hatch out from the eggs at once but continue to emerge during the period of a fortnight and this may even extend to a month in some localities after they first begin to appear. Unless larvae can find a suitable spot in a soft

sappy part of the twig within a few hours, it dies. It pierces through the cortex and buries its proboscis in the tissues and comes to rest in this position. Unless it can do so it dies. When full grown the female and male pair and the male dies. When the eggs mature the female dies. The larvae issue through the anal orifice or through rupture in the skin. The lac now contains much smaller amount of colouring matter than before the eggs hatch out but the incrustation is never free from colouring matter. The insects are propagated from tree to tree, through the agency of wind, birds, and other insects, since the larvae are so minute and light as to be easily blown by a window or carried about through other means. The question of pruning the trees is discussed by Mr. Lefroy in the Agricultural Journal of India. It is to be done to supply proper succulent twigs to the insects to feed upon.

The lac insect is not without its enemies. They Pproag mals (birds, squirrels, monkeys), insects,(ants, &c.) are aniforces (frosts, hails, rain), forest fires and lastly the ignorant men or thieves. This subject is fully dealt with in Mr. Stebbing's monograph.

Propagation of the lac insect and collection of lac are discussed fully by Mr. Lefroy, Sir George Watt, Mr. Stebbing and the previous writers on the subject. The twigs covered by lac incrustations are cut off about 15 days or a month before the larvae come out. A certain number of these branches six inches to a foot in length are tied on to unaffected branches of trees, upon which the insect is to be propagated. We should assist the spread of the insects and help them to reach easily and in a short time, the places where they can get suitable food ; this prevents the larvae from dying.

Next I turn to *the food plants* ;—This is closely com

nected with the distribution of the insect and under this head I have discussed the necessity on the part of the experimenter to find out trees fit for each district.

The present state of the Industry in the Bombay Presidency:—As noted by Mr. Stebbing, Sind supplies a good object lesson in respect of introducing the industry and shows what the Railways, irrigation, forest, military departments, local bodies like the municipalities, local boards and private individuals can do in this respect.

Lac yielding trees mentioned by Mr. Stebbing:—

1 Acacia Arabica, 2 Acacia Catechu, 3 Albizzia Lebbeckia, 4 Allizzia Lebbekoides, 5 Albizzia Lucida, 6 Aleurites Moluccana, 7 Anona Squamosa, 8 Artocarpus Fintegrifolia, 9 Baulinia sp., 10 Butea Frondosa, 11 Butea Scandens, 12 Butea Superba, 13 Cajanus Indicus, 14 Careya Arborca, 15 Carissa Carandas, 16 Cassia Siamca, 17 Castanopsis sp., 18 Celtis Roxburghi, 19 Ceratonia Diligua, 20 Cordia Myxa, 21 Croton Aromaticus, 22 Croton Obiongifolius, 23 Dalbergia Cultrata, 24 Dalbergia Latefolia, 25 Dalbergia Paniculata, 26 Dalbergia Oliveri, 27 Dalbergia Ovata, 28 Dichrostachys Cinerea, 29 Dipterocarpus Tuberculatus, 30 Dolichandrone Rheedii, 31 Echinocarpus Assamica, 32 Erioloena Hookeriana, 33 Erythrina Indica, 34 Feronia Elephantum, 35 Ficus Alternarina, 36 Ficus Altissima, 37 Ficus Bengaleusis, 38 Ficus Caricas, 39 Ficus Comosa, 40 Ficus Cordifolia, 41 Ficus Cunia, 42 Ficus Elastica, 43 Ficus Glomerata, 44 Ficus Infectoria, 45 Ficus Laccifera, 46 Ficus Nervosa, 47 Ficus Obtusifolia, 48 Ficus Palmata, 49 Ficus Religiosa, 50 Ficus Rumphii, 51 Ficus Tjakela, 52 Flemingia Congesta, 53 Garuga Pennata, 54 Glochidion sp., 55 Grewia Lœvigata, 56 Grewia Tiljœfolia, 57 Jamiferus macropoda, 58 Kydia calycina, 59 Lagerstroemia parviflora, 60 Mallotus philippinensis, 61 Mangiferaindica, 62 Nephelium Litchi, 63 Odina Wodier, 64

Ougeiniadal bergioides, 65 Prosopis spicigera, 66 Pantacine
 siamensis, 67 Pentacmesuavis, 68 Pterocarpus Marsupium,
 69 Pithicolobium bigeminum, 70 Pithicolobium Dulee,
 71 Pithicolobium saman, 72 Schima Crenata, 73 Schlei-
 chera tujuga, 74 Shorea Obtusa, 75 Shorea Robusta, 76
 Shorea siamensis, 77 Shorea Talura, 78 Spatholobus
 Roxburghu, 79 Stercospermum feinbuatum, 80 Streblus
 asper, 81 Tamraiadus indica, 82 Tamaria gullica, 83
 Teetona Grandis, 84 Thespesia Carr, 85 Terninalia
 Towentosa, 86 Xylia dolabriformis, 87 Zizyphus Jujuba,
 88 Zizyphus xylopyra.

The chief trees of the Poona District, on which lac is found to grow and which may be experimented upon are :—
 Amba, Ain, Sag, Dhaman, Pimpal Palas, Babul, Bor, Khair, Erand, Sitaphal, Chinch, Apta, Canchan, Shami, Tur, Anjer, Asan, Bhokar, Bakul, Karvand, Kavath, Pangara, Phanas, Pimpari, Shirus, Umbar, Vada, Tivas.

In a list of 88 trees given by Mr. Stebbing only 9 trees are mentioned on which lac can be grown in Bombay and Sindh. I have, however, named above, more than 27 trees to show that there is much room in the Bombay Presidency for investigation and experiment.

The following points should be carefully noted while making experiments as pointed out by Mr. Stebbing.

Distribution—The lac insect is widely distributed throughout the Indian continent and exists upon a variety of different trees

A peculiarity of this distribution, however, is that where as it flourishes best on one or more particular species of trees in one locality, in a different part of the continent, it will be found to thrive on other species even though the trees upon which it does best in the former area may be present in the latter. This anomaly in the life history of the pest may be due to two causes. (i) The sap of a plant

varies with the amount of moisture in the atmosphere, the amount of heat and the nature of heat whether damp or dry, to which the insect is subject. Motherlac should be only taken from trees of the same species or species which have a harder wood than those of the host plants. (ii) There may be more than one species, sub-species or race of the lac insect present in the country. This point although of very considerable scientific interest and importance has not upto the present received much attention. This point will be pursued further in my paper. These two conditions, which appear to affect the distribution and food of the lac require to be borne in mind when experiments are made in introducing the insect into localities in which it is at present absent or in the extending cultivation on a large scale. For instance, negative results would probably follow the attempted propagation of individual of the lac insect inhabiting dry and hot localities such as Central India into the humid warm tracts of western Bengal and Asam and *vice versa*.

Bombay and Sind.—In Bombay the lac industry appears to be confined chiefly to the Panch Mahals. It is obtained in small quantities from Dobad and from the forests of the neighbouring States of Ali Rajpur, Udepur and Deogad Bariya. The chief lac yielding trees are *Ficus* (Pimpal) Religious, *Beetiafrondosa* (Palas), *Zizyphus Jujuba* (Bor) and *Schleichera trijuga* (Kusumba).

2. In Sind lac is found along the Indus and to the South of Hyderabad. It does well in both the Hyderabad and Jurruc forest Divisions. It grows chiefly on *Acacia aribica* (Babal), but is also found on *prosopisspicigera* (shami), *Zizyphusjujuba* (Bor), *Albizzia Lebleck*, *Jaramise gallica* and *Ficus bengaleusis* (*vad*).

The average annual revenue in Sind for five years from 1905—1906 to 1909—1910, was Rs. 10,850. In the four years

1905—1909 the export was cwts. 9,387 worth Rs. 1,086,982. On Bor, Sirus and Banian, lac is seen mostly along roadsides, banks and canals. Bor and Babul yield 7 to 15 shers per tree, Banian yields 1 to 2 Maunds, and sirsu yields 1 to 1½ Maunds.

Injury done by the lac insect to the trees. In Sind the riverine reserves of Babul where there is much moisture in the sub-soil do not suffer to an appreciable extent from the deprecations of the insect, on the sap and the lopping of small branches, but probably in regions where the rainfall is moderate and forest growth owes its existence to rain, the insect pest may affect the trees. Rarely and in the case of certain species of trees only are the trees killed by the lac insect.

The above remarks show that trees along the banks of rivers and canals and roadside trees in the vicinity of small streams are not in danger of being damaged by the lac insect.

The commonest roadside trees of the Poona District fit for lac are the Babul, Pinpal, Vad, Nadruk, Pimpri, Tamarind (Chinch) and Umbar.

There are trees in cantonment grounds and they can be made to yield revenue to the cantonment fund. The Municipalities and Local Boards own trees which they can utilize for lac propagation. In Dhulia there are Pimpal trees which yield lac yearly and the Municipality collects it through Bhils and earns a small income. It may take up the work and supply motherlac and increase the produce. The trees should be placed under the charge of the Superintendent of the Government Model Farm.

I make special mention of three trees Babul, Tur, Erand. Tur and Erand are perennial trees in this district and experiments on these trees deserve serious attention,

According to Mr. Stebbing, in Asam the insect lives upon *Cajanus Indicus* (Tur) and this fact should be carefully noted. There appears to be every reasonable hope of a large industry growing up by the careful cultivation of lac upon a plant, which could be grown by short rotations, without the risk attendant on its cultivation upon large trees. Lac cultivation on *Cajanus Indicus* is said to yield more valuable returns than cotton cultivation. This lac can be put on other lac rearing plants. *Lac Nurseries* are to be strongly recommended in Asam and many parts of India. -

Experiments must be made before anything can be stated definitely.

Lac Cultivation on Babul.—The Imperial Entomologist Mr. Lefroy observes :—

"A very important plant is the Babul (*Acacia arabica*) which in Sind bears lac which is of great value. There could be a very large extension of lac cultivation on this plant which grows freely in very wide areas in India. On this tree especially there could be a very large production of lac on *canal banks*, on *waste land* and wherever this tree occurs. Its potentialities as a lac producer are equal to those of Ber (Bor) and there is immense scope for lands being rendered profitable that are now of little value except as a source of firewood and grazing for goats. *Babul lac* is apparently a distinct species and to start the cultivation, one must obtain the motherlac from Babul. This proposition about species does not stand the test of my experiments and will be dealt with separately, Babul lac is obtainable in Sind, Rajputana, and the driest parts of North India and is not known to occur elsewhere."

(The Agricultural Journal of India, Vol. 4, Part 3 of 1909.)

The remarks deserve the attention of every person interested in agriculture and the future of lac industry.

Lac insects are to be found in the Poona district in several places. I looked into the Gazetteers of Panch Mahals, Nasik, Khandesh, Satara and Poona and found the mention of the lac insect on a few trees as a natural product, I

could get no other Government records to trace the point. In the Bombay Presidency *the artificial cultivation* of lac is recently commenced at Bassein. In the latest Bombay Administration report sericulture is mentioned but lac is conspicuous by its absence.

The Government nurseries should be so equipped as to meet the public demand for mother-lac. *District officers* can take interest in this matter and induce the wealthy agriculturists in different Talukas and villages where they have suitable trees, to propagate lac insects and serve as nurseries. In future agricultural shows and demonstrations, the lac culture may be given some space so that it may come to public notice. At the request of the secretary of the Ratnagiri Agricultural Exhibition, I sent an essay in Marathi, which was read there.

What the Railway authorities can do in this respect.—In the Bombay Presidency alone there are 4318 miles of Railway. In the Poona district there are about 200 miles of Railway. Some of the trees along the Railway lines are lac producing trees. What a source of capital is lying idle? They have an army of servants. If the lower grades are taught the culture of lac insects what a quantity would be grown. There are thousands of trees with favourable natural conditions. The Railways can be their own producers of lac. A portion of the produce may be allowed to the servants for their trouble. They will have an opportunity to learn something new, add to their own earnings and to those of their masters, furnish an object lesson over the length and breadth of the country in lac culture and promote a useful industry. The Railways require sealing wax which could also be manufactured from their own raw materials. If figures as to the total amounts spent on varnish and the sealing wax for the Railway administration be obtained as also the number of trees along the Railway lines suitable for

lac cultivation ; some preliminary work would be done. When a large number of people is employed in the industry their experiences, will make a substantial addition to our present knowledge of the subject. A Government Bnttleu and supply of mother-lac with trained supervision for some time will, it may be hoped, achieve some practical results. The experiment is worth a trial. The spare time, of the Railway servants that is now practically wasted deserves to be utilized in lac cultivation.

What the Irrigation Department can do in this respect.— Like the Railways the irrigation department can do much. In the United Provinces the length of the Irrigation canals was 15,083 miles in 1911. Interest at nearly 6 p. c. on the capital was realised. The department owns trees valuable for lac culture. Their subordinates can be trained to the work. They may be remunerated by the share in the produce. Most of the remarks applicable to the Railway servants are applicable to these subordinates also. Both the Railway and Irrigation Departments can do the work departmentally or under a contract system, or through their subordinates or all the three systems can be tried. Contractors may not be found for some years until they know that the experiments are working at a profit. Meanwhile statistics may be collected as to the lengths of the canals, the number and nature of trees useful for lac culture and the localities best suited to start the work. Sind has taken the lead in this matter. As far as canals are concerned it is not a new departure. I do not know if Railways earn anything from lac as an additional source of income. The Irrigation Department can certainly take up the work of lac culture. The length of the canals in this district is not less than two hundred miles. The number of trees may possibly be 50,000 or more by the sides of the

canals. Government is seriously thinking of further extending irrigation by canals and the number of trees will thus go on increasing. It will therefore be desirable to have a scheme framed for utilising the trees growing on the banks of canals. In Poona at my request a small beginning is made.

What the Forest Department can do.—The department has the greatest facilities. They are in charge of the forests nearly all of which abound with trees suitable for lac culture. The training of its subordinates fits them for this kind of work. It is their legitimate duty to increase the produce and revenue from forests. In taking charge of the forests, the state undertakes to make them pay the most in the light of advanced scientific knowledge: Government has in its service specialists and their experience and practical suggestions ought to increase the revenue. Sir Thomas Wardle has remarked that if the Government of India developed sericulture on scientific lines, the silk industry ought to be equal to that of the cotton mills and able to recoup the loss of revenue from opium. Why should not lac also supplement the revenue when artificial cultivation of it is extended under Government guidance and patronage? It is possible for the Forest Department to ascertain the probable number of trees and thus to furnish the necessary information as to the trees fit for lac cultivation.

According to Mr. Stebbing, "There may be more than one species, sub-species, or race of the lac insect present in the country. This point although of very considerable scientific interest and importance, has not up to the present received much attention." Mr. Lefroy shares the above view. As my experiments throw some light on this question, the views of Mr. Lefroy that Babul lac is a distinct species are open to reconsidera-

tion. My experiments show Babul lac insect to be a subspecies of Bor lac or of the same species as Bor and Sita-phal and UMBER lac.

After the above discussion, it will be fit to quote Mr. Stebbing's inspiring conclusions with Mr. Purun Singh's views and then to state my own on the whole subject. Mr. Stebbing observes :—

"With the exception of the Central Provinces, the Forest Department has not realised the immense value of lac as a minor forest product. It may be held that lac cultivation is not the work of the forest officer and when the cultivation has been taken up in a systematic manner throughout the country it may well be that the Forest Department will be in a position to make it over to the villagers in the district lands outside reserves, to the Native State, and to the private Zamindar. At present however the position has to be faced that *the cultivation of the product on scientific lines is not understood*. But little advance has been made in the production of the substance since the days of Akabar and the daily increasing demand for the product, of which India is the chief producer, would seem to necessitate considerably more attention being paid to its proper collection than has been the case in the past. To this end, since it is peculiarly a product of tree cultivations, it would seem desirable that *the Forest Department should turn its attention to working out the best methods by which a largely increased and sustained yield can be obtained and to cultivate object lesson crops all over the country with a view to gradually winning the native cultivator from his at present quite inadequate methods of supplying the existing demand. As matters are now shaping there appears to be but small reason to doubt that money expended in this work will yield very large returns.*" (A note on the lac insect by F.P. Stebbing, Vol. 1, part 3, page 48).

My conclusions are as follows :—

(1) The present very insignificant *revenue* from lac as a minor forest produce can be increased by the forest, irrigation, and Railway departments of Government on the lines suggested by Mr. Stebbing.

Forest officers can do this by working departmentally or on contract system. The same applies to the other two departments.

(2) The waste lands in charge of the revenue autho-

rities and cantonment lands can also be utilised if district officers and cantonment authorities take interest in the matter.

(3) If private persons are persuaded to take to lac cultivation, the pecuniary value of lands can be improved and it will help to add to the income and prosperity of the Rayat as it is not an essential of lac culture that the lac insect should be cultivated only in groves of trees or forests. The cultivation can equally be carried out on scattered trees of the proper species in hedgerows, as well as in cultivated land. In this branch, district officers and those of the above named departments might come forward to guide, persuade and provide object lessons. Intelligent and well-to-do land-holders and Inamdars and persons of position can help a great deal in this respect.

(4) That the Native States will not be slow to follow the example. Baroda is already said to be doing what is advocated here. It is therefore desirable that—

(a) Government should issue bulletins in all the languages, giving practical instructions on the life history of the insect, the method of propagation and collection of lac to ensure the best results.

(b) Government should establish lac nurseries, to serve object lessons, under the supervision of some energetic officer or private individual.

(c) Lac should be shown in all future agricultural shows and demonstrations.

(d) The supply of mother-lac should be sufficient to meet public demand.

(e) Information about prices and markets should be available to likely sellers of the produce.

(f) Experiments by private persons should be encour-

aged, those by Government should not be confined to a few trees and the reports and information should be available.

(g) The bibliography on the subject should be published as a part of the bulletins for advanced students.

(h) Steps should be taken to see that the cultivation of lac goes from ignorant hands to persons conversant with present scientific methods.

(i) Samples of twigs of the lac producing trees, with drawings and descriptive explanations as well as the names of the districts where they can be found should be prepared.

(j) Prompt and urgent action on the part of Government and private persons is needed as the price of lac is rising as a result of increasing demand for the product for electrical works out of India and for the manufacture of gramophone records. I have not lost sight of the fluctuating prices of the commodity. In the Bombay Presidency we are having a pioneer electric work and let us be prepared to supply its want of lac rather than be importers as at present the Bombay Presidency is. It is also extensively used as a varnish and polish for furniture and metal, as a stiffening material for hats, as an ingredient in lithographic ink and as sealing wax and in various other ways. In India, lac enters very largely into the agricultural, commercial, artistic, manufacturing and domestic operations of the people. This is more fully treated in the Agricultural Ledger No. 9 (1910) by Sir George Watt in his "Lac and Lac Industries." Let us be our own producers and suppliers of raw and manufactured product of lac and a vast field for work and remunerative investment is open before us only if we will avail ourselves of the natural resources of our country. The spirit of the times is co-operation, scientific research, application of scientific methods and mass

education. Let us apply these to the present question and practical results will not be wanting.

German scientific researches ruined the lac industry and what follows will show how Indian research and scientific discoveries are again likely to resuscitate the lac industry.

Analysis of the young living larvae of the lac insect shows that they contain about half their weight of soluble colouring matter. Lac incrustations are not free of all colouring matter after the swarming of the larvae from them and to free the seed lac from the dye, washing processes will have to be undertaken under all circumstances. The colouring matter has a most baneful effect on shellac, inasmuch as its presence tends to deteriorate the quality of the article. This colouring matter is known to be held very tenaciously in the crystalline deposits of the lac grains.

Mr. Puran Singh's method of refining lac by the aid of woodspirit (methyl alcohol) is expected to produce a greater and purer yield of shellac from crude lac than hitherto. A considerable saving of labour, cost of manufacture and obtaining a larger quality of resinous principles are expected to make the lac industry a much more profitable concern than it is now. (A note on the manufacture of pure shellac by Mr. Puran Singh, F.C.S. etc., to be had from Superintendent, Government Printing, Calcutta, price 8 annas).

The differences in qualities of lac from different places are either due to difference in the food of the insect or may possibly originate in the species or sub-species of the insect or may be determined by a combination of both these circumstances.

Methyl alcohol extracts from lac its resinous matter alone, leaving other ingredients unaffected ; it does not in any way injure the structure of the crystalline portion of lac resin. The resinous matter of lac consists of several

resins having different composition and existing in different specimens of lac in varying proportion. The resulting refined products obtained from different lacs were all found by Mr. Puran Singh to resemble the best shellac of commerce in all their chief properties and characteristics.

If precaution is not taken in collecting lac from trees, it is pressed down and becomes co-agulated and commands less price than that from which the larvae have swarmed out. In the co-agulated lac the mother insects die of suffocation and get decomposed in cells, with the result that the lac cells get co-agulated into a sort of ugly mass.

Mr. Puran Singh's method will in the opinion of Mr. Avasia, Instructor at the Imperial Forest College will not only revolutionise the old methods of manufacture of lac now followed (described in Sir George Watts' book and Puran Singh's note) but confer a great boon on the villagers who carry on the lac industry by saving them a lot of trouble which they now take in carrying and storing the lac. Mr. Puran Singh's method will thus remove the groundless prejudice about the superiority of one kind of lac over another. Chemical analysis shows that both forms of lac can well be used for shellac manufacture.

The apparatus employed for the extraction of lac with wood spirit is not very costly, and can be easily constructed anywhere at no great expense. The spirit used is not all lost but can be utilized several times. A low melting point secured in lac by the old method is not a necessity for the chief industrial purposes to which shellac is put in Europe and America.

Mr. Puran Singh sums up his conclusions on pages 15 to 17 of his note which will amply repay perusal. His illustration of the apparatus is instructive. The working of it is fully described by him. It is expected

that the article refined by the new process will find a ready sale, and command higher prices in the market than the product obtained by the old method.

I will quote his words, as he advocates the cultivation of lac like Mr. Stebbing, in his note on the lac insect; he remarks "It will not I hope, be out of place here to accentuate the importance of increasing and improving the cultivation of the lac insect and the collection of the lac incrustations. Since by the process of lac refining pure shellac can be manufactured from all forms and varieties of crude lac, and since the lac insect can live on a variety of different trees and is found throughout the whole of India, there appears to be no reason why its cultivation and propagation on scientific lines should not be extended wherever it is possible (Mr. Stebbing has given a long list of the principal trees on which lac can grow). The most important are I *Acacia Arabica* (Babul, Kikar), II *Butea Frondosa* (Dhan, Palas), III *Cajanus Indicus* (Arhar, Jur) *Ficus Bengaleuris* (Banyan tree), *Ficus religiosa* (Pimpal) *Ficus Rumphii* (Jhuri), *Schleichera trijugu* (Kusam) and IV *Zizyphus jujuba* (Bor). (The figures indicate the grades of quality of the lac. The rest would go in a lower grade). The methods at present used for lac cultivation and collection are extremely crude, imperfect, and sometimes wasteful, and it is well in the interests of the country that prompt steps should be taken to improve and increase the production of lac."

Application of the scientific methods and research in all the stages of the industry is the only way to resuscitate and expand it and to maintain it in the face of the competition of the scientists of the civilised countries.

BENGAL JUTE AND ITS MANUFACTURES.

BY ANNADA PRASAD GHOSH, ESQ.,

Commercial Intelligence Department, Calcutta.

If there is any Indian fibre, remarkable for its gloss, fineness, facility of spinning and at the same time cheapness, it is jute which now plays an important part in the textile industry of the world.

Jute is chiefly grown in almost all the districts of Bengal. The principal jute-growing districts are Dacca, Naraingunj, Faridpur, Backergunj, Hugli, Bogra, Julpai-guri, Mymensing, Rungpur, Rajshai, Purnea, Tipperah, Pabna and Dinajpur. In Assam it is cultivated in Goalpara only. The area under jute cultivation in India is about 3 million acres.

Jute can be fairly cultivated on such soils as are loamy, rich in clay and sand. A hot and wet climate with too much rain in May and June is most suitable to the jute crop.

Silt deposits and Cow-dung are good manures for jute.

For jute cultivation the preparation of the soil begins in December when the field is ploughed and cross-ploughed; ploughings are made five to six times, the clods are pulverised and the soil levelled. The sowing of seeds begins by the end of March and extends to the end of May. The quantity of seeds required for one bigha of land is $1\frac{1}{2}$ seers. The ordinary harvest time commences in the beginning of July and extends to the end of October. After the plants have been cut down and branching tops lopped off they are left in the field for 2 or 3 days for the falling off of the leaves. The stalks are then gathered and

tied into bundles. The bundles are afterwards carried off and submerged in stagnant pools. The bundles are made to sink by placing on them clods, bricks and pieces of wood. This period of decomposition of jute plant in water is generally 15 days, after which the labourer goes down about knee-deep in water and begins removing the fibres from end to end of the stems, without breaking either stem or fibre.

As soon as a handful has been collected, he washes it off by dashing it repeatedly against the surface of the water. Then, water is wrung out of the fibres and afterwards small bundles of this fibre are suspended on ropes tied to posts to dry in the sun. The different varieties are classed as "Good," "Medium" and "Ordinary" according to their qualities. The average yield per bigha may be estimated at 5 maunds which at the rate of Rs. 6 per maund may fetch as much as Rs. 30. The average cost per bigha being about ten, the net profit to the grower comes to Rs. 20 per bigha.

Jute plant is an economic product of great value. Its raw leaves are eaten as potherb and dry leaves as an alterative and febrifuge medicine. The stems after the extraction of the fibre may be used for making gun powder charcoal. The fibre gives us the following manufactured articles of much usefulness:—(1) gunny bags, (2) gunny cloths, (3) strings, ropes and cords, (4) nets, (5) net-like bags, (6) strips of cloth for tying bales of cotton etc, (7) cradles for children, (8) floor-cloths, (9) painters' brushes and those for white washing, (10) false hairs for actors and actresses, (11) muzzles for cattle, (12) *sikas* for holding kitchen pots &c. Jute is also interwoven with silk, linen and woollen threads into cheap cloths.

Jute manufactures of Bengal possess a respectable antiquity. Trade in gunnies, ropes and twist has ever been a signi-

ficant part of the Bengal peasant's work. Goto any peasant's hut and you will find a few bundles of jute hanging from a rafter in the thatched roof of the verandah which the peasant twists either by means of a reel called a *dheri* (native name) or by the *takur* (native name of the tool) into twine of various thickness intended for the handloom gunnies or other domestic purposes. Hugly, Dacca, Rungpur, Murshidabad, Malda, Dinajpur, Jalpaiguri are the principal centres of the handloom jute industry. The economic value of jute fibre was quite unknown to Europe before 1828 when the term "Jute" appeared for the first time in the Customs Trade Returns and it was in that year that 364 cwt. of jute were sent to Europe. But its economic value was not appreciated till 1832 when an enterprising Dundee manufacturer successfully demonstrated that the fibre might be used as a substitute for hemp. With this successful experiment a new industry was started in Europe to the greatest advantage of the commercial world. Good many mills sprang up in Dundee for the manufacture of ropes and gunnies for the export trade in grain. The result was that the importation of cheap gunnies from power looms checked the indigenous industry of Bengal and Bengal peasants shortly found it more profitable to supply good fibres to feed Dundee mills than to devote their time and energy to the hand-made manufactures. In India, however, no machinery was established till 1854 when Mr. Ackland, a rich owner of coffee plantations in Ceylon first established the "Rishra yarn mills" near Serampur. Then followed Baranagore jute mills and others. The mills in Bengal are mostly in every direction around Calcutta. There are good many factories in the northern part of the city for the baling of raw jute. Before I conclude, I quote two sets of figures—one for 1881-82 and the other for 1910-11 to show clearly how

the volume of export trade in jute (raw,) gunny bags and gunny cloth has wonderfully expanded in the course of the last thirty years.

Exports from Bengal and Eastern Bengal to foreign countries.

	Jute raw cwts.	Gunny bags No.	Gunny cloth yds.
In 1881-82	7,510,081	41,315,100	975,111
& In 1910-11	12,671,251	359,184,557	954,318,177

REQUISITES OF INDIAN PRODUCTION.

BY PROFESSOR J. N. SAMADDAR, B.A., F.R.E.S., F.R.H.S.,
M.R.S.A.
Hazaribagh.

India is essentially an agricultural country. Agriculture is and must remain the most important of all her industries. 80 per cent. of India's people depend exclusively on agriculture and in one way or other the remainder has also a great connection with it (1). As the Editor of the Imperial Gazetteer rightly observes "The predominating feature of agriculture in India is that it gives occupation, directly or indirectly, to an immense majority of the population of the country. The Census returns show that in British provinces the proportion of the total population directly engaged in agriculture was 62 % in 1891 and 68 % in 1901, the corresponding figures

(1) Sir D. M. Hamilton speaking at the Benares Conference observed : " At a time like the present, when the public gaze is so fixed upon Swadeshi manufacturing industries, the all-important fact is apt to be lost sight of that Swadeshi manufactures are almost entirely dependent for their success on the success of agriculture. That this is so will at once be apparent when it is realised that the manufacture of Swadeshi piece-goods can only be successfully established when it has been found possible to grow suitable cotton and that when the growing and manufacturing problems have been solved, the question of markets will be found also to depend on agriculture for the simple reason that the great market for piece-goods is the agricultural population and the more flourishing the population is, the more can it afford to spend on manufactures."

for Native States in those years being 57 and 60 %." He then goes on to say that out of 287,000,000, population in 1891, 175,000,000, and out of 294,000,000 in 1901, 196,000,000, were directly dependent upon agriculture proper and cattle-rearing.

Number of persons subsisting on.	British India.	Native States.	Total.
<i>Provision and care of animals.</i>			
Stock-breeding & dealing ...	2,745,486	1,159,183	3,904,669
Training and care of animals...	57,058	14,904	71,962
Total ...	2,802,544	1,174,087	3,976,631
<i>Agriculture.</i>			
Landholders and tenants ...	122,727,972	29,956,276	152,684,248
Agricultural labourers ...	30,310,064	5,098,774	35,408,838
Growers of special products ...	1,783,660	844,960	2,628,620
Agricultural training and supervision ...	856,269	113,756	970,025
Total ...	155,677,965	36,013,766	191,691,731
Grand Total ...	158,480,509	37,187,853	195,668,362

In fact 9/10ths of the rural population depend on agriculture and there has been even an increase of it as will be seen from the following statement :—

Cattle-breeders and attendants,	} an increase of 331,000 bet. 1891 and 1901.
Landowners and tenants ...	
Labourers ...	2,753,000
Growers of special products...	16,736,000
Supervisors of estates ...	367,000
	100,000
Total...	20,287,000

An Industrial Revolution is happening all throughout our land, but before success can be attained in that sphere, it is thoroughly indispensable that our prime industry should be placed on a sounder foundation. It is admitted even by the extreme protectionists that agriculture must reach a high state of development, before manufactures can be brought to

develop (1). I, for myself, venture to think that the more we take stock of our requisites of production, and think over them, the better for our country.

Let us first take LAND.

In India, there is plenty of land and the soil is proverbially and wonderfully productive. The Law of "Diminishing Return" is operating and will operate, resulting in the gradual cultivation of the "very poorest description of the soil", still there is enough of land lying waste which can be profitably brought under cultivation. Sir John Strachey writing some 16 years ago, observed "Exclusive of Bengal for which there are no statistics, there are said to be in India some 80,000,000 acres of unoccupied land fit for cultivation—an area exceeding that of the United Kingdom." (2). The aspect of affairs, as judged from the latest available statistics stands thus.—

Classification of Areas (in square miles) 1903-04.

Provinces.	Total area.	Net cropped area.	Forests.	Not Avl.	Current fallow.	Total occupied area.	Cultivable or other than fallow.
Madras ...	1,01,109	42,147	10,766	20,772	9,556	51,703	8,868
Bombay ...	1,15,983	42,661	18,323	30,369	17,545	60,206	12,465
Bengal ...	1,52,453	76,454	8,210	37,746	10,573	87,027	19,470
United Prov.	1,03,971	55,799	14,482	13,556	3,206	59,005	16,928
Punjab ...	89,270	38,924	5,412	12,999	3,805	42,729	28,130
Burma ...	1,62,530	19,679	18,625	32,808	4,934	24,613	86,484
C. P. & Berar.	96,710	38,611	20,965	8,256	5,131	43,742	23,747
Assam ...	28,894	7,730	3,778	3,148	1,980	9,710	12,258
Frontier ...	13,280	3,638	527	5,532	602	4,240	2,981
Total ...	8,63,600	3,25,643	57,332	3,82,975			
	8,63,600	3,25,643	1,04,088	2,15,186	57,332	3,82,975	16,135

(1) As I said in the Surat Conference, "It is said that History repeats itself. In England, the era of Arkwright, Crompton, Hargreaves was preceded by the era of agriculture. And, therefore, if the real regeneration of India must come, history should repeat itself here also and the great industrial activity which is being marked throughout the country must be preceded by agricultural activity." (Vide Report of the Surat Industrial Conference, Page 336 ff.)

(2) Sir John Strachey's India, Page 305.

(This table excludes feudatory and tributary states and areas for which no returns are available.)

Cultivation in India is hampered by many causes, notably among them want of rainfall—a defect which we cannot altogether avoid, though we can minimise its effects. Rainfall in India is a very uncertain factor. Some parts of this "vast Continent" suffer from excessive, while other parts from deficient rainfall. To avoid this, we should have more and more of irrigation. A Government authority rightly observes "without artificial irrigation, large areas in India would be permanently wasted, or could be cultivated only in years of exceptionally favorable rainfall." (1)

The Indian Famine Commissioners speaking of the value of the Irrigation works of the North-Western Provinces thus said :—"Up to the end of 1877-78, the capital outlay on completed canals had been £ 484,000. The area irrigated in that year was 1,461,000 acres, the value of the crops raised was estimated at £6,020,000. Half the irrigated area was occupied by autumn crops, which, but for irrigation, must have been wholly lost, and it may be safely said that

(1) As the Editor of the Imperial Gazetteer observes "India contains large tracts, such as the deserts of Sind and the South-Western Punjab which are practically rainless and in which cultivation without irrigation is impossible. There are others, such as the Deccan plateau, where cultivation is exceedingly precarious, owing to the great irregularity of the rainfall and the long intervals during which crops may be exposed to the fierce heat of the sun and to dry and scorching winds. In other more favored tracts, such as the Himalayan submontane district a serious failure of the rainfall is seldom or never known, yet also irrigation works are of the greatest value in improving the out-turn of the crops. Lastly, there are districts which ordinarily receive so copious a rainfall that rice is almost the only crop grown: but for this, water is required at certain critical periods when there may be a break in the rains and a full harvest can only be secured by irrigation. In general, it may be said that the security of the harvest depends on the existence of some form of irrigation, in almost all parts of India." I quote this almost, if not almost a hacknied, passage, just to show how Government officers look on this question and how, as I have endeavoured to prove, Government does not act in the way.

the wealth of these Provinces was consequently increased by £3,000,000 ; so that three-fourths of the entire first cost of the works was thus repaid to the country in that single year. In 1891-92, the area irrigated by canals in the N. W. Provinces exceeded 2,000,000 acres."

Sir Henry Cunningham in his "British India and its Rulers" thus writes of Punjab: "During the droughts of 1877-78, the benefits were extended to 1,333,000 acres, the greater portion of which would, but for canal irrigation, have been absolutely barren." During this period, the land irrigated by the two principal canals produced food grains to the amount of 300,000 tons, worth £2,000,000 sterling, and enough to keep 18,00,000 people for a year ; while the non-food crops—sugar, dyes, spice, etc.—were reckoned to be worth another £1,000,000. In other words, the value of the crops saved by the two canals in a single season was more than equal to the entire cost 52,260,000 of the completed system."

Thus said Sir Richard Cunningham, and commenting on it, another authority, no less than Sir John Strachey, observed "The benefits described by Sir Henry Cunningham have become far greater since this passage was written." Referring to the Sirhind Canal, Sir John observes that it is capable of discharging 6,000 cubic feet of water per second ; the length of its main channel is 540 miles ; and it can irrigate 1,200,000 acres. "Its cost has exceeded Rs. 4,530,000 and the direct returns to the State in 1890-91 amounted to about 4·6 % on the Capital expended,"—which considering the Government rate of interest $3\frac{1}{2}$ seems to be a good return.

The Irrigation Commission of 1901-3 estimated the total area ordinarily irrigated in British India from all sources as

(1) "Excluding the large areas directly watered by river floods there are many-thousand acres which though directly irrigated in the ordinary sense, are artificially saturated by rain water held-up within field embankments." (Imperial Gazetteer.)

below, the total cultivated area being taken at 226,000,000 acres:—

Sources of Irrigation.	State works.	Private works.	Total.
Acres.	Acres.	Acres.	Acres.
Wells ...		12,895,000	12,895,000
Canals ...	15,644,000	1,235,000	16,879,000
Tanks ...	29,44,000	5,194,000	8,188,000
Other sources ...		6,184,000	6,184,000
Total ...	18,588,000	25,510,000	44,098,000

The aggregate capital outlay to the end of 1902-3, on Major and Minor works together, amounted to nearly 48 crores, and the area irrigated from them in that year was about 14,000,000 acres. The annual value of the crops raised by the works for which capital accounts are kept is estimated in 40 crores, or about 88 p. c. of the capital outlay thereon. The Irrigation Commission of 1901-3 observed that "the Major irrigation works constructed by the state have been on the whole so profitable, that the surplus revenue, after meeting all interest charges on the capital outlay, now exceeds a crore of rupees a year."

Taking all these things into consideration, we are led to think that more money should be employed for purposes of irrigation than what is being done. Railways, as is urged, are useful in times of scarcity and famine, but undoubtedly prevention is better than cure. But during all these years, the capital outlay on irrigation comes to 46 crores as against 346 crores incurred on railways, although the return from irrigation is an average of 4.6 p.c., as against 1.05 p. c. from State Railways.

We have taken a lot of time on this topic—no doubt a very important one. We shall therefore content ourselves with noticing only 2 more points on the question of Land. Of these the first is the fact that in India, holdings are small and thus agriculture has to be carried on a small scale.

Production on a large scale which has its advantages cannot be resorted to. This, however, cannot be remedied or avoided. From time immemorial the laws of succession have done this. (6)

Passing over other minor points we turn to the second requisite of production, namely:—

LABOUR.

Up to the present, Dr. Voelcker is considered as the authority on matters relating to Indian Agriculture and akin matters. As is well-known, the learned Doctor was appointed in 1889, to investigate the subject of Indian Agriculture and to report on the measures that might be adopted for its improvement. Dr. Voelcker spent over a year in India, devoting himself to practical and scientific enquiries and the result of his labours is the "Report on the Improvement of Indian Agriculture." Dr. Voelcker observes "At his best, the Indian ryot or cultivator is quite as good as, and in some respects the superior of, the average British farmer, while at his worst, it can only be said that this state is brought about largely by an absence of facilities for improvement which is probably unequalled in any other country; and that the ryot will struggle on patiently and uncomplainingly in the face of difficulties in a way that no one else could." And again "Taking the ordinary arts of husbandry, nowhere would one find better instances of keeping land scrupulously clear from weeds, of ingenuity in the device of water-raising appliances, of knowledge of soils and their capabilities, as well as of the

(6) "In considering the possibility of agricultural improvement in this sense, it is essential to bear in mind the economic state of the country, which determines, in the most rigid way, the limitations of effective action. The country is one of small holdings and high interest; the cultivator himself has little or no capital, and the rate of interest is prohibitive. There is no use in trying to convert small holdings into large ones: such a change would run contrary to the social organisation of the people, and would probably not increase income on the whole: we must therefore make the best of our small holdings." (Benares Industrial Conference: Mr. Moreland's Paper.)

exact time to sow and to reap, as one would in Indian Agriculture and this not at its best alone, but at its ordinary level. It is wonderful too how much is known of rotation, the system of mixed crops, and of fallowing. I have never seen a more perfect picture of careful cultivation, combined with hard labour, perseverance, and fertility of resource, than I have seen at many of the halting places in my tour." (7).

Dr. Voelcker in fact, gives a very good certificate to our Indian cultivator. What is true of the Indian ryot or cultivator, is to a certain extent true of the general mass of Indian labourers. They have the knack of acquiring skill and learn the art of foreigners. It also seems to be cheap and abundant. But in spite of its seeming abundance and cheapness, Indian labour is inefficient and dear in the long run. Our labourers are on the whole ignorant and generally unenterprising. They are also careless and we have also to fight with his "poor physique and hence poor outturn." Over and above all these, Indian labour is altogether immobile. In some parts it is over-congested, in others is not at all available. Very great inducement is necessary to coax them from a congested area "half-starving through insufficient employment" to another where it can have plenty of food. The rate of wages in different parts of India and Burma varies from 2 to 15, in round numbers. In Bengal, it is at an average 6, Assam 8, Agra 8, Oudh 2, Punjab 7, Madras 4, Bombay 7, Central Provinces 4, and Burma 15. This for an ordinary labourer. For a skilled labourer, say, a mason, carpenter, or blacksmith, it varies from 6 to 32, in round numbers. In Bengal the average is 11 to 15, Assam 13 to 32, Agra 8 to 10, Oudh 6 to 7, Punjab 18 to 20, Madras 13 to 15, Bombay 17 to 22, Central Provinces 12 to 18, and

(7) Sir John Strachey whom we have several times quoted also writes "The Agricultural classes are certainly not inferior in intelligence to the peasants of many of the countries of Europe" (India: Its Administration and Progress, Page 396.)

Burma 27 to 32. The minimum is therefore 6 to 7 in Oudh and the maximum is 27 to 32 in Burma.

Earnest endeavours should, therefore, be made to "tap" labour from congested districts and so long as this does not take place, this diverse rate must prevail. Mr. Foley, an able officer who was deputed by Government to enquire into these affairs, thus opined: "There would still seem an enormous reserve of labour in the congested districts of the United Provinces to draw upon, and there need be no apprehension at present that the supply is likely to be exhausted." A brother officer of Mr. Foley, Mr. Freemantle concurred in this view. As Khan Bahadur Bezoni Dadabhoy Mehta of the Nagpore Empress Mills once wrote, "There would seem to be no room for doubt, that there are immense potentialities for a plentiful supply of comparatively cheap labour in numerous congested areas. Only, it needs sustained and organised efforts to coax it to leave the paternal home where it half starves, and migrate to industrial centres affording more lucrative pursuits."

Climatic conditions also require that labour should be mobile. Bengalee and Madrassie labourers suffer as they do from great heat and great damp,—extremes of climate—soon lose their strength and it is but indispensable that we shall draw labour from the hardworking labourers of the Upper Provinces.

Over and above all the disadvantages mentioned above, we have to deal with uneducated labour. The agitation for free and compulsory primary Education is a move in the right direction. The efforts of all our leading men are being directed to this Question (8).

Lastly, there is the great want of capital, which takes us to the third requisite of Production,—CAPITAL—and the question regarding the indebtedness of the Indian cultivator, want or rather the shyness of indigenous capital and the often-discussed Question of the Utility of Foreign capital.

(8) Vide Modern Review, March 1911.

CAPITAL.

Mr. Moreland, the Director of Agriculture and Land Records, U. P. in his able and well-written paper "The present position of the agricultural industry of the United Provinces", which he submitted to the First Indian Industrial Conference at Benares, thus observed :—

"The provision of cheap capital is very much the most important agricultural improvement that can be suggested, simply because it is the condition precedent of improvements of other kinds. Go among the cultivators themselves, and ask each man what it is that he wants in order to make a larger income out of his holding. You will find that nearly every answer is a request for capital in some form or other. One man wants a well, but cannot afford to make it : he wants capital. Another man wants more or stronger cattle : he wants the capital to buy them. Another wants to hold his produce till the harvest-glut in the market is over : capital is again what he needs. Another would grow wheat instead of gram, if he could afford the seed : another would grow sugarcane, if he could pay for the labour needed : another would grow potatoes, if he could get the manure : All alike are tied down by the want of capital which compels them to make an inadequate use of their holdings."

What is true of the poor, heavily-indebted cultivator is true of all in some form or other. The passing of the Co-operative Credit Societies Act, its smooth working and progress, and the growth of C.C.S. all over India—all are tending to relieve the poor debtors. But what about the capital for the big industries ?

There is enough of capital in India, but it is at the same time too shy. One former Viceroy of India estimated that our hoarded wealth is £55,000,000, *i. e.*, 825 crores. As an able writer very forcibly puts it "Much of it is locked up in the state jewels in our Native States, a considerable part in the people's ornaments, and only a small residue at the best is available for purposes of industrial development."

Of the 105 crores of rupees invested in Government securities, 55 crores belong exclusively to the Indians. There is a deposit of 15 crores of rupees in the Savings Banks of which 18 crores are our own. We must coax this hoarded wealth to come out of its sockets and have it employed in our industries.

The citizens of Bombay are setting a splendid example to their brothers in other parts of India. But, it is undoubtedly a pity that this example is very little followed. Elsewhere in India, as Mr. O'Connor aptly points out, "the amount of capital invested in industrial undertaking by the Indian community is almost, in comparison with Bombay, non-existent." Of course, a change is taking place, though very very slowly, and indigenous capital is being gradually employed. At the same time I am definitely of opinion, that Government should resort to some measures which would make investing more secure. Before we hasten to say, that the more and more coming out of indigenous capital, is due to the examples taught by our foreign capitalists, we may add that excepting the cotton industry, which is generally in our hands, and where Indian capital is employed, the other so called "indigenous industries" are not at all indigenous in any sense. These are financed by foreign capitalists and the agency is also foreign. We get only the wages of our labourers.

The following 3 tables show the amounts of European capital and Indian capital invested in India, in various industries.

A

(EXCLUSIVELY UNDER EUROPEANS)

Industries, &c.	Capital	No. of persons employed.	Annual production.
Railways	480 crores	5.15 lakhs	81,500 miles open.
Tramways, &c.	8½ crores	...	...
Jute Mills	15 crores	1.92 lakhs	...
Gold-Mining	4.88	...	£.217 Million.
Woollen Mills	44½ lakhs	8511	3½ million lbs (worth Rs. 44 lakhs).
Paper Mills	58.8-4959	57 million	(Worth Rs. 75 lakhs)
Breweries	25 lakhs	lb 1658-5	(¼ million gallons of beer).

B

(MAINLY UNDER INDIANS)

Industries, &c.	Capital	No. of persons employed.
Cotton Mills	20½ crores	236,000.
Ice Factories	16 lakhs	...
Cotton Presses	Statistics not available	75,000.
Jute Presses	Do	27,000.
Printing Presses	Do	16,500.

C

(MAINLY UNDER INDIANS)

Industries	Capital	Persons employed.	Annual production.	Value
Coal Mining.	6½ crores	1.29 lakhs	12,75 mil.	5 crores.
Petroleum	...	...	177 mil. gal.	1 crore.
Tea	24 crores	5 millions	247½ mil.	...
Ten Exchange Banks	38 crores	...	...	...
Three Presidency and	...	...	...	...
13 J. S. Banks.	9½ crores	...	...	...
Rice Mills	1.94 crores	21,400	...	...
Saw & timber Mills	82 lakhs	8800	...	...
Flour Mills	58 lakhs	2821	...	...
Sugar Factories	1.25 crores	6865	...	...
Iron & Brass Foundries	...	...	...	...
Indigo Factories	...	26,000.	...	...
	...	42,124.	...	...

Prof. Kale speaking of "our serfdom" to foreign capital and to foreign enterprise analyses the state of certain industries. He says "Take the Tea industry, for example. The total area under cultivation increased from 540,533 crores in 1907 to 548,127 acres in 1908 and the total number of plantations from 5811 to 5839. The total production of tea was some 247 million pounds, of which about 234 millions valued at 10.39 crores of rupees was exported; which seems to be the highest figure on record. The industry employed more than 5 lakhs of laborers, being an increase of thirty thousand over the previous year. The capital of the Joint Stock Companies engaged in the production of tea amounts to nearly 24 crores, *viz.*, companies registered in India Rs. 8.86 crores, companies registered in London, Rs. 20.22 crores. Now here is an important industry carried in India, employing 5 lakhs of men and with a capital of 24 crores, an industry bigger than even the Cotton Industry. But the most remarkable thing about it is, that it is almost wholly controlled by Europeans and nearly 83 per cent. of its capital comes from companies registered in London. There were in 1907-08, some 50 Jute mills in India employing 188,000 persons. The paid up capital of 49 of these was £8,664,000. In 1908-9, the exports of raw-jute were estimated at about 20 crores of rupees, while jute manufactures were exported to the value of 15½ crores. The whole of this important industry is in the hands of Non-Indians. The same remark applies to the output of Indian minerals the total value of which raised during 1908 was returned as £7,828,745 against £7,079,708 in 1907, an increase of 10 per cent."

Indeed as the Gaekwar so forcibly put forward "We are being fed and clothed, diverted and entertained, lighted and washed, warmed and comforted, carried and housed, by the foreign artisan." (9). Even the "Statesman and Friend of

(9) Sir Vithaldas Thackersay characteristically observed "When we turn to the petroleum industry in Burma, the gold mines of Mysore, the coal mines of Bengal, the tea and jute industries, the carrying trade

India " in one of its issues dated February 19, 1908, speaking of the mining industry and its development by English capital opined not merely the children of the soil must be content for the time being with the hired labourer's share of the wealth extracted, but that the exportation by the remainder, involves a loss which can never be repaired. Though the blame, as the "Statesman" went on to say, largely rests with us, Englishmen could well understand the jealousy with which the people of the country regard the exhaustion, mainly for the benefit of the foreign capitalist, of wealth which can never, as in the case of agriculture, be reproduced. "It is in truth no mere foolish delusion, but an unquestionable economic truth, that every ounce of gold that leaves the country, so far as it is represented by no economic return, and a large percentage of the gold extracted by foreign capital which is represented by no such foreign return, implies perennial loss."

The "Statesman" while agreeing that the people of the country reap no benefit whatever from the employment of foreign capital, in the exploitation of Indian resources, goes on to observe that out of a greater or smaller share (quota) of the value of the mineral wealth extracted, people get only wages and royalties. But, undoubtedly the price paid is much too great for the advantages accruing from them to the country.

This same view is held by Sir Thomas Holland, for some-time, the Director-General of Geological Survey to the India Government. Referring to the Petroleum industry and the petroleum fields of Burma, Sir Thomas observed "The one regrettable feature is the fact that the capital required to drill the deep wells has been raised in Europe and the profits consequently have left the country. In the petroleum industry, as in so many other enterprises of the kind, India will continue to pay an unnecessary and undesirable tax as

by sea and the financing of our vast foreign trade by foreign Banks we come upon a less favorable aspect of the question of the investment of foreign capital."

long as those in the country who possess money will not risk their reserve fund in industrial purposes."

The closing words of Sir Holland in the above-quoted passage deserve more than a passing notice. We must have foreign capital, so long as we do not get indigenous capital, so long as Sir Holland aptly puts "as those in the country who possess money will not risk their reserve fund in industrial purposes." Japan and Canada are resorting to foreign capital to better their industries. Although there is some difference between India and the two countries just mentioned, still we can follow suit and have as much of foreign capital, though we must take care that we do not pay for more than other nations. Of course, it would have been, to a certain extent, better for the nation, if our minerals had remained unexploited for years and years, and then developed for by the "newly awakened and highly trained native industrialists of the future," but no one can deny the great educative influence of foreign capital on us, which is day by day coaxing our hoarded wealth to come out and taking all things into consideration, it would be foolish not to take recourse to foreign capital. (10).

We have tried to discuss in this unusually long paper, the 8 requisites of Indian production. With the spread of primary education, the establishment of more and more of co-operative credit societies and of indigenous banks, the supply of cheap capital and the extension of irrigation works, and the honest efforts of the people with the hearty co-operation of the benign Government, there is still much we can expect to achieve. With a firm faith and reliance on "the immutability of the principles of justice and righteousness," let us work for the amelioration of our people and the salva-

(10) "A hundred million pounds sterling so borrowed from the foreign capitalist on easy terms and judicially laid out, would not only be the means of enabling us to start numerous industrial enterprises on the newer lines but also of effecting a vast ameliorative change in the economic life of the people so as to send light and hope, comfort and joy, in thousands of cheerful homes in a way of which we could have at present but a dim idea."

tion of our country. And let us always, ever and anon-remember the immortal lines of the great BHAGBADGITA.

"Karmanye badhikarastey ma faleshu kadachana,

"Ma karmafallahethur bhurmatay sangostwa karmani."

OIL-PRESSING IN THE BOMBAY PRESIDENCY

BY DR. H. H. MANN, D. SC.,

Principal, Agricultural College, Poona.

The amount of oil-seeds produced and either pressed in or exported from the Bombay Presidency is enormous, as is indicated by the following figures of area under these crops for the last five years* :—

	1905—06 Acres.	1906—07 Acres.	1907—08 Acres.	1908—09 Acres.	1909—10 Acres.
Castor seed ...	64,878	80,081	1,09,507	85,514	88,628
Groundnut ...	77,616	91,568	1,10,100	1,09,065	1,28,457
Rape and mustard ...	987	4,228	2,985	4,076	5,099
Linseed ...	1,99,629	1,53,879	1,89,446	1,48,241	1,33,309
Niger seed ...	1,69,863	1,82,726	1,96,428	2,10,141	2,17,222
Til or Jinjili ...	3,68,432	4,43,241	4,15,601	3,55,434	3,92,553
Safflower ...	3,58,714	3,34,403	4,21,867	5,52,330	4,19,923

In addition to the crops produced on these areas there is a very large import into the Bombay Presidency from the surrounding states and provinces chiefly as follows † :—

1. *Castor seed* from the Nizam's Dominions amounting to 7,18,080 maunds in 1909-10.

2. *Rape and mustard seed* from the United Provinces amounting to 12,24,806 maunds in 1909-10, from the Central Provinces amounting to 1,09,829 maunds in

* The figures given throughout this paper do not include Sind.

† Figures are only given where the import exceeds one lakh of maunds.

1909-10, and from Rajputana amounting to 2,05,660 maunds in the same year.

3. *Linseed*, as follows in 1909-10 :—

From	Maunds.
Central Provinces and Berar	8,83,571
Nizam's Dominions	5,70,454
Rajputana and Central India	5,02,972
United Provinces... ..	2,25,929

4. *Poppy seed*, as follows in 1909-10 :—

From	Maunds.
United Provinces	4,92,832
Rajputana and Central India	3,79,025

5. *Til seed*, as follows in 1909-10:—

From	Maunds.
Central Provinces and Berar	14,51,406
Rajputana and Central India	8,89,611
United Provinces	8,41,627
Nizam's Dominions	6,27,408
Mysore	1,68,522
Goa... ..	1,48,213

6. *Unspecified seeds* (chiefly safflower, I think), as follows in 1909-10:—

From	Maunds.
Central Provinces and Berar	38,11,081
Nizam's Dominions	14,43,354
United Provinces	7,24,840
Rajputana and Central India	5,00,625
Madras	1,01,307

Most of the production and import is exported direct to Europe, from the port of Bombay, or is pressed in the local bullock-worked country "ghani" which is found in almost every village. I do not intend in the present paper to attempt to describe the country methods of press-

ing oil-seeds. Suffice it to say that sweet oil for edible purposes is prepared in every corner of the country, and this consists, on the Deccan principally of a mixture of niger seed oil, safflower oil, and groundnut oil: in Khandedh it is largely til oil, though linseed oil is used when it is cheap. In other regions I have not got data as to the principal constituents of the ordinary country sweet oil.

The present report will, however, deal chiefly with oil pressing as a large scale industry, which is just at the commencement of its development in the Bombay Presidency. I have, in the inquiry I have made, attempted to get into touch with every existing oil mill in the Presidency. In most cases I have succeeded and have been treated with the greatest courtesy in every case.

Before giving a list of such mills, I may perhaps describe the present limits of their probable extension :—

(1) Their extension appears, at present, to be absolutely limited by the local demand for oil—either sweet oil for eating, linseed oil for paints (a small matter), and castor oil as a lubricant. All unite in stating that the production of oil for export will not pay.

(2) The extension of castor seed crushing depends also on the demand in India and the East for castor cake as a manure.

(3) The extension of the crushing of seeds used for sweet oil depends on (a) the local demand for feeding and manure, (b) a considerable export demand chiefly from Liverpool for making into compound feeding cakes. This applies to groundnut, til, niger seed and safflower seed.

The question of cotton seed I will deal with separately.

The following are oil-pressing mills which exist and are worked in the Bombay Presidency, or have been recently closed.

(i) GUJARAT.

1. *Sabarmati Oil Mills near Ahmedabad.*—These belong to the Bombay, Baroda and Central India Railway, and crush castor seed exclusively, the oil being chiefly used by the railway. I was not able to get particulars of this mill and the machinery used in it, but I am given to understand that it crushes about eighteen to twenty tons of castor seed per day.

2. *Gujarat Oil Mill, Ahmedabad.*—This mill crushes about twelve tons of oil seed per day, chiefly castor, rape and linseed. As a matter of fact castor is the principal seed crushed, and the others only as ordered. The chief demand for castor cake is from the Deccan, and most of the cake is bought to send there. The mill is fitted with Rose, Down and Thompson's machinery. I visited the mill myself.

3. *Rajnagar Oil Mills, Ahmedabad.*—This is a smaller mill than the last and is used almost exclusively for castor seed of which, working day and night, six tons per day is crushed. The equipment is also that made by Rose, Down and Thompson. I visited the mill myself.

4. *Shree Sayajee Seed Oil Mill, Baroda.*—Although called a cotton seed oil mill, this now no longer attempts to crush cotton seed. In fact cotton seed was only worked about one month after the mill was opened, owing to the small percentage of oil obtained (under twelve per cent.) and to the lack of demand for the unrefined oil. The proprietors then turned to crushing castor, til and similar seeds and it is answering satisfactorily. It has machinery capable of dealing with eight tons of seed per day, though not more than four tons is crushed. The machinery again is Rose, Down and Thompson's. I visited the mill myself.

5. There is, I understand, a small oil mill at Thasara in the Kaira district, and one at Petlad in Baroda, but I got no particulars of them.

6. A mill for crushing cotton seed was established about three years ago at Broach, but it only worked about two years and is now closed. From what I can gather there was considerable ignorance of the subject on the part of the promoters. The question of refining was a difficulty, though the demand for the refined oil was very good. There was also some difficulty in getting rid of the cake.

7. A mill has been recently closed at Mehsana, North Gujarat, which, I am informed, was used to crush ten tons of castor seed per day with six horizontal presses worked by manual power. The machines were obtained from Jessop & Co., Calcutta, and the seed is said to have usually given from 40 to 45 per cent oil.

(ii) BOMBAY AND NEIGHBOURHOOD.

1. *Peeroo Mahomed Oil Mill.*—This is the largest mill in the Bombay Presidency and belongs to a limited liability company under the management of Messrs. Glade & Co. of Bombay. It deals with about forty tons of oil-seeds per day, and when running goes day and night. The machinery was all obtained from Messrs. Greenwood and Batley of Leeds, and the later portions are very up-to-date consisting of a revolving double press giving circular cakes. The seeds usually dealt with are castor, and all the seeds giving sweet oil. The proportion of each of the latter varies much according to season, as they are largely inter-replaceable as edible oils. I visited this mill.

2. *Firoze Oil Mill.*—This is a newly established mill in Bombay. It has dealt with oil-seeds for sweet oil exclusively up to the present, principally groundnuts. Experi-

ments, only, have been made with cotton seed. The machinery was supplied by Mr. Robert Middleton of Liverpool, the hullers being American and made by Foss & Co. of Springfield Ohio.

3. Messrs. Tata Sons & Co. have recently established a mill at Kurla near Bombay to crush cotton seed. It has made little more than a commencement as yet.

4. *Indian Cotton Oil Company at Navsari.*—This company is also recently established, and I have not got particulars as to its size or machinery. It is, however, making excellent decorticated cotton cake, perhaps the best I have yet seen in India.

(iii) DECCAN AND SOUTHERN MAHRATTA COUNTRY.

Oil mills in the Deccan and Southern Mahratta country have not hitherto been a very great success, but these have been established on a small scale and hence perhaps could hardly be expected to do very well. I have heard of the following mills :—

1. *New Prince of Wales Oil Mills, Hubli (Dharwar).*—This was established at Hubli, but was removed three years ago to Pulgaon in the Central Provinces.

2. *Dattatraya Oil Mill, Shirpur (Khandesh).* This mill was started in 1906 and worked about three years. It was not financially successful, and is now being voluntarily wound up. Its machinery was by Musgrave Brothers and consisted of two hydraulic presses with the necessary apparatus for crushing and heating. It was capable of crushing five tons of seed per twenty-four hours, and the 'sweet oil' seeds til, safflower, linseed, and groundnut were almost entirely used.

3. *Sholapur Oil and Flour Mills.*—This mill has not yet started business.

4. *Hirachand's Oil Press, Sholapur.*—This is a small oil mill about which I have not been able to get full particulars.

5. *Vartak Oil Mill, Poona.*—This mill has been established for crushing safflower seed little more than a year ago. The machinery was purchased through Messrs. Greaves, Cotton & Co. of Bombay. All the cake has hitherto been sold as manure in the local market.

6. I am told that there are small oil-pressing plants as follows, but they have not supplied information to me :—

The Barsi Oil Mill, Barsi.

The Karad Oil Mill, Karad, Satara.

A small plant near Dharwar.

All these are, however, very small concerns.

As far as I can judge, therefore, the total amount of oil-seeds pressed by power machinery in the Bombay Presidency excluding Sind does not exceed one hundred tons daily. The largest part is castor seed, as there is a considerable demand in this case for both oil and pressed cake. There is a large local demand for oil from the 'sweet' oil-seeds, namely, til, groundnut, niger and rape.

The average amount of oil actually obtained from the various seeds is as follows, although it is not always safe to calculate on so much :—

	Per cent.
Linseed.	32 to 34
Rape	36 to 37
Castor	37 to 39
Til	40 to 42
Niger	21 to 22
Safflower	16 to 20
Groundnut	37 to 39

As has already been stated the extension of the large scale oil-pressing industry is, in my opinion, absolutely determined by the local demand for oil. It will, I am assured by those most qualified to know, only in very rare cases, pay to press oil-seeds in order to export the oil, and any effort to extend the oil-pressing industry must primarily consist in an effort to extend the utilisation of vegetable oils here. There are two great lines of development here, namely, devising of a suitable vegetable substitute for ghee, whose price is continually rising, and the extension of the soap industry. Both of these methods merit a long statement, but this is hardly the proper place for it. I should like special emphasis laid on the opinion that oil pressing, as a large industry, depends first and foremost on local demand for the oil.

In the Bombay Presidency there is at present little difficulty in getting rid of the oil cake chiefly for manurial, but partly for feeding purposes. First, with regard to castor cake: There is a continual and heavy demand for this from the sugarcane irrigation tracts of the Deccan, and castor cake is drawn to those areas from Bombay, Gujarat and other centres outside the Deccan. During the present year castor cake has been brought from Lahore to the Deccan. The cake always obtained contains from 4 to 4½ per cent. of nitrogen, and is worth Rs. 40 per ton, on contract, at the Bombay Mills, the cost of removal to be borne by the buyer. The actual cost in Poona, which is one of the two large centres of distribution, during the present year is as follows:—

	Per ton
Bombay Mill cake.	Rs. 61 to 63
Punjab Mill cake.	„ 48 to 53
Gujarat Mill cake.	„ 63 to 66
Gujarat bullock pressed cake.	„ 64 to 66

The sales are conducted in pallas of 240 pounds, but I give the price in tons. The Deccan is able to absorb easily all the castor cake available with the present mills.

Other cakes, as produced by power mills, have a smaller local demand, and it is more profitable to export them than to sell them locally. The demand for feeding is met, and easily met by the village mills which abound, except for a small demand for groundnut cake. The only demand for manure is that for safflower cake. As this is produced in local bullock mills, it is very rich, owing to being largely decorticated before crushing. Under these circumstances it forms one of the best manure or feeding cakes that we have, and often contains over 8 per cent. of nitrogen. It is an exceedingly effective manure cake, and has been heavily pushed by the agricultural department. It is worth, in the present year from Rs. 58 (January) to Rs. 74 (May) per ton in the Poona Bazar. The safflower cake from mills, on the other hand, is much less decorticated, if at all, and usually contains only a little over four per cent. of nitrogen as a result. It is only worth in Poona about Rs. 45 to Rs. 50 per ton, and at this price is hardly worth bringing up even from Bombay. Other cakes produced by mills, have only a small, practically a negligible demand as manures.

In Baramati, the centre of the Nira irrigation area, where the demand for castor cake and safflower cake is very great, the prices in March 1911 were as follows:—

	Per ton
Castor cake (from Gujarat Mills)	Rs. 61
Safflower cake (from local bullock presses) „	59

In this case safflower is a large local crop, and there is a considerable industry in pressing it with bullock ghanis.

In the Deccan the demand for cake is increasing constantly. It is almost always used for sugarcane top-dressings, its only competitor being fish manure. It is being more and more used for garden crops, and for fruit trees.

In the Southern Maratha country,* the available cakes for manure are safflower and Karanji (*Pongamia glabra*). The former is, however, never used as manure, and the whole of the safflower cake produced is either fed to cattle or sent to Poona. Castor cake is never used. Karanji cake, even, is not used as manure. Nearly all the seed being usually exported to Bombay. There is a bone crushing factory belonging to a Mr. Cowen at Hubli. This factory buys all the three oil cakes, safflower, castor, and Karanji. The cakes are finely crushed and mixed with the bone meal, when the mixture is sold to Mysore coffee planters as manure. There will probably in the future be a large market for oil cake in the Southern Maratha country.

In Gujarat, oil cake, chiefly castor cake, is used as a manure for garden crops, sugarcane and certain fruits. Sometimes it is also given to turmeric and occasionally to rice. As in the Deccan locally pressed "sweet" oil cakes are used for feeding, but practically no mill-made cake.

In general the demand for oil cake for manure is an expanding one,—and it will expand further. The new canal areas now being opened will cause a large increase in the demand in the near future, and if there is a market for the oil, there will be one certainty for the better class of manurial oil cakes.

Recently an export demand for cakes for manure has sprung up from Ceylon. It is only a recent matter, and I am not aware how far it has gone.

* This information has been kindly supplied by Mr. M. L. Kulkarni, Divisional Inspector of Agriculture.

I have still to refer to two or three special seeds.

1. *Cotton seed*.—Cotton seed has not hitherto been successfully pressed in the Bombay Presidency, though many efforts have been made for the purpose. Three reasons have been given to me for the failure.—

(a) The small percentage of oil given by our seed. Not more than 12 per cent. is usually obtained.

(b) The fact that the oil is no use for eating without refining, and refining to be economical must be done on a large scale.

(c) There is little demand for the cake at present.

These reasons are, I think, adequate. The first would not be sufficient if it stood alone. But only when the demand for cake increases and its price becomes greater,—and when consequently it will pay to construct refineries, is cotton seed pressing in this Presidency likely to be a large established industry.

2. *Mhowra seed*.—This is produced and pressed in large quantities, and there is also an enormous export of the seed, amounting to 9,18,453 maunds in the last year. It is used as a 'sweet' oil. The cake, however, rarely contains much more than 2 per cent. of Nitrogen (my last analysis gave 2.17 per cent. Nitrogen), and it is hence an inferior manure. I have found it used for adulterating some of the more valuable cakes, and it is likely to be employed more for this purpose as their price advances,—as it will.

3. *Karanji seed*.—The seed of the Karanji tree is sent from the Southern Maratha country for pressing to Bombay. As the cake is not suitable for feeding, it forms one of the cheapest forms of manure, and can be bought in and near Bombay. Its quantity is however limited.

Such are the results of the investigation which I have been trying to make into the present condition of the oil pressing industry in Bombay. The oil-pressing industry is in its comparative beginnings. Its future depends first and foremost, on the increase in the local demand for oil. In the Bombay Presidency we have already a demand for cake which takes, as manure, all the castor cake produced, and more,—and which would compete, if the price were only a little higher, with the export demand from Liverpool, for feeding cakes. This rise of price seems certain to come,—and then the increase in the demand for oil will be more than ever the dominating factor in determining the extension or otherwise of the industry.

THE HONEY BEE AND PROSPECTS OF BEE-KEEPING IN INDIA.

BY M. K. RAY, ESQ., B. SC., F. G. S.,
State Geologist, Alwar.

The honey bee belongs to the genus *Apis* of the animal kingdom. I suppose the honey bee is an insect with which all of us are more or less familiar. Every colony of bees is tenanted by three kinds of bees, namely, workers, drones and a queen.

The workers constitute the main population of a colony, they number from a few thousand to 50 thousand or more. They do all the work of the colony, such as gathering and storing honey, building combs, nursing the young bees, etc. They are imperfectly developed females. The workers possess stings which they freely use, in defence of their home against all aggressors.

The drones are the males. The number of drones in a colony varies from a few only to several hundred. They are reared in spring and are generally killed out on the advent of the cold weather. They do not do any work of the colony. The drones are very much larger in size than the worker bees, they make a great noise in coming in or going out. On watching a colony of bees at work, the drones can easily be distinguished from the workers by the amount of fuss they make and their size. The drones do not have stings.

The queen is the only fully developed female in a colony. She is distinguished from the workers by possessing an elongated body. She lays all the eggs, all the other bees in the colony are her children. A queen is mated only once in her life. The mating always takes place in the open air when the queen is on the wing and never when she is on a comb. As a rule, 2 or 3 days after the mating the queen starts laying eggs, and this she continues to do for the rest of her life, which generally

lasts from 3 to 5 years. During the summer months the queen lays as many as 3,000 eggs daily, but during the cold weather she lays very few eggs and sometimes none at all. The queen has a sting but she will rarely use it unless it is against a rival queen in the same colony. After her nuptial flight a queen never leaves a colony except when she accompanies a swarm.

Workers, drones and queens are reared in different kinds of cells. The drone cells are larger than worker cells, while for rearing queens the bees prepare a special kind of large cells. The queen lays two kinds eggs—male and female. Workers and queens are both reared from the same female eggs, the difference in the mature insects being due to difference in feeding at early stages. The queen possesses the power of laying male or female eggs at her will; thus, she will never lay male eggs in worker cells or female eggs in drone cells, that is, supposing she is a good healthy queen.

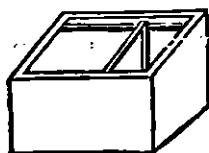
During the summer, when any colony gets overcrowded, the bees "swarm." That is, they divide themselves into two batches, and one batch leaves the old home and emigrates to a different place. When the bees intend to swarm, they build a dozen or so of queen cells. When some of these cells become mature, the old queen with a batch of bees leaves the colony. When the first queen hatches out in the old colony, the bees generally destroy the other queen cells. But sometimes they do not do so, and a second queen hatches out. A royal battle then ensues between the rival ladies and it has fatal consequences for one of the combatants.

KEEPING BEES.

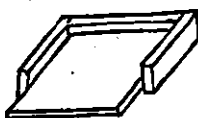
Bees have been domesticated by human being for quite a long time. The ancient Egyptians used to keep bees and so did the ancient Greeks. In India bees have been kept in hollow tree trunks by certain hilly tribes from

time immemorial. In England, as also on the continent of Europe, bees have been kept in little straw baskets known as "skeps", for several centuries.

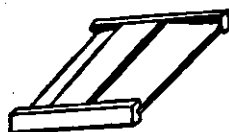
Hive body with
one frame.



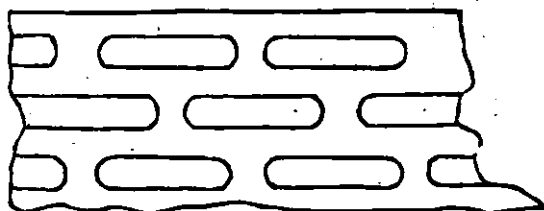
Floor Board.



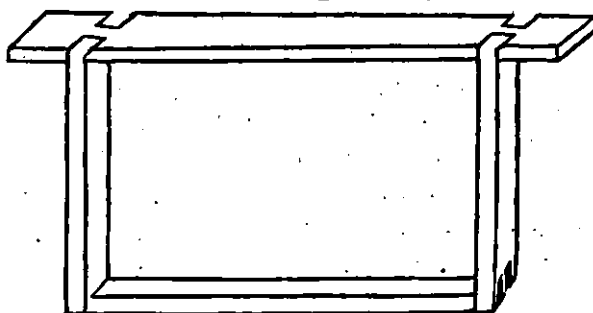
Hive Cover.



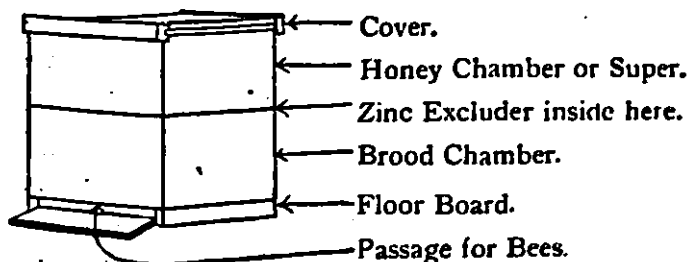
Zinc Queen and Drone Excluder. (Larger Scale)



Frame. (Larger Scale)



Complete Hive.



It was however the introduction of movable frames, foundation combs, and extractors during the last fifty years that established the claims of bee-keeping as a paying rural industry. I shall try to explain briefly the principal outlines of modern practice in bee-keeping.

A "hive" means a home for bees provided by man. An "Apiarist" means a bee-keeper, it has nothing to do with apes. "Apiarian" means relating to the bees.

A modern hive consists of two or more rectangular wooden boxes, open top and bottom. These are placed one above the other, on the top of the top chamber is placed a cover and below the bottom chamber is placed a floor board. When so placed, there is a passage left between the bottom chamber and the floor board, for the bees to get in and out of the hive.

In each of the chambers, are allowed to hang a series of rectangular wooden frames, which are fitted with foundation combs. A foundation comb is a sheet of bees wax which, by having been passed through specially prepared embossed rolls, has impressions on it, imitating as nearly as possible bases of natural built combs. The bees readily accept these foundation combs and build cells on them. The principal object of giving these foundation combs to the bees, is to induce them to build straight combs in the frames. When the bees have drawn out all the combs in a chamber, we have in the chamber a series of parallel combs, each like the ones we are used to see on the branches of trees. Each of these combs is in a frame which can be lifted out of the hive for examination.

On the top of the bottom chamber, before the second box is placed, is laid a sheet of perforated zinc. It has already been remarked that both the queen and the drones are of larger size than the worker bees. The perforations

of this zinc sheet are large enough to allow worker bees to pass through but not large enough to allow passage to the queen or the drones. The result of putting in this zinc excluder is that neither the queen nor the drones can go to the upper stories. As the queen cannot go to the upper chamber, no eggs are laid there and the bees have to use that place for storing honey.

The bottom chamber where the queen lays all her eggs and where all brood is reared is called the brood chamber and the upper chambers where honey is stored are called "supers."

When the bees have filled up the combs in the supers with honey and have capped over the cells, the Apiarist removes the supers, takes out the frames, uncaps the cells by passing a heated knife over them and extracts the honey from them by means of an extractor. An extractor is a machine in which the frames are revolved at a great speed by turning a handle and honey from the combs is thrown out by centrifugal force. After extracting, the empty combs are returned to the bees who again start storing honey in them.

Those who are nervous, use, when working amongst bees, bee veils for protection of head and face and sting-proof gloves for their hands.

INDIAN BEES.

The native bees of India are different from those that are domesticated in Europe and America. The bees cultured in Europe and America belong to the species *Apis Mellifica*. Although the literature on bees is something enormous, published account of Indian bees is very meagre indeed. At the time when I was learning my first lessons on apiculture, in England, five years ago,

the only reliable information that I could get on Indian bees, was from the accounts of Sladen and Frank Benton. Both these gentlemen had come all the way to India, one from England and the other from America, to study the Indian bees. I learnt from their accounts that there are three species of bees in India, namely, *Apis Dorsata*, *Apis Indica*, and *Apis Florea*. When I returned home this year, I thought of having a look out for the bees. I had no difficulty in finding and identifying *Apis Dorsata* and *Apis Indica*, but I have not so far seen any bees answering to the description of *Apis Florea*. On the other hand I have seen several kinds of bees not described by the previous observers. I will briefly describe the Indian bees as I have seen them.

Apis Dorsata.—*Apis Dorsata* or the giant Indian bee is found all over India,—at least I found them in north-east Assam, in Bengal and also in Rajputana. The workers possess long yellow abdomens, the tips being black. During the summer months they build one single large comb which they attach to a branch of a tree. The cells which are intended for storing honey are made of pure snow white wax, while brood cells are made of an almost transparent papery substance. This bee is very much larger in size than *Apis Mellifica* of Europe and America, in fact their workers are as large as good sized queens of *A. Mellifica*. The area of their brood cells however is scarcely greater than the area of those of *A. Mellifica*. But the cells of *A. Dorsata* are very much longer; uncapped brood comb of *Apis Dorsata* is $1\frac{3}{4}$ ths inch thick while that of *A. Mellifica* is only $\frac{3}{4}$ ths inch thick. *Apis Dorsata* does not build larger cells for rearing drones. This bee seems to be very susceptible to cold. On the approach of the cold weather they get into sheltered spots within easy reach of watering places and remain there for about three months. During

this time they do not build any comb but just huddle together and they do not seem to eat anything, only at about midday they may be seen to go for a sip of water. At the time of writing this paper—last week of November—these bees have taken up their winter quarters, but the little bee with one yellow and three white bands described later, is busy gathering in honey and pollen from the numerous winter flowers of this part of the country (Eastern Rajputana). The giant Indian bee has for a long time appealed to the imagination of a large number of European and American apiarists, particularly the American apiarists, who have thought of introducing them into America. There are some, however, who are afraid that their introduction in America would bring about a sort of an apiarian "Yellow Peril". They fear that the giant bee will drive out of America all the other races of bees. This argument will hardly hold good seeing that in India they have not yet driven out the other bees.

This bee has never yet been domesticated. When this paper was promised, I was thinking of making some experiments on their domestication. But, unfortunately, being on the move for the most of the time, I have not yet been able to carry out my experiments. At the time of writing this paper, however, I have some experiments in hand and I shall be glad to have communications with any one who might feel interested in the subject.

Apis Indica.—I found plenty of these bees in Digboi in Assam. They are pretty to look at, with rings of yellow about their abdomen. They are shorter than *A. Mellifica*. They are very industrious, and I understand that they are being kept in modern hives in a few apiaries in Dibrugarh, Darjeeling, Simla and Kashmir.

Next in size to the *A. Indica* is a bee with one yellow

and three white bands. The drones are quite black but are covered with a sort of white fur; they are very much larger than the workers. I have seen this bee in Bengal as well in Rajputana. Their honey is considered excellent.

Smaller than the above and just a shade larger than the common house fly is a bee with three white bands but no yellow band. The drones are quite black. They build combs as big as a man's hand. A curious thing about them is, that they simply won't sting. There is little doubt that they could be easily domesticated, but they collect very little honey. They may however be useful for such special purposes as gathering lotus honey. I found these bees in Digboi.

I also found in Digboi a little bee almost as small as a mosquito. The workers are jet black in colour with no yellow or white bands. This bee is so small that one cannot hear their buzz.

It seems to me that we have in India a larger number of races of bees than has been so far supposed.

PROSPECTS OF BEE-KEEPING IN INDIA.

Judging by the number of races of honey bees that flourish in India, our country may be truly said the "Home of the Honey Bee". In this land of the ardent sun, we get flowers in abundance all the year round; but so far we have made no attempt to tap their honey flow. From an economic point of view, we have absolutely neglected the flowers and have left them to "waste their sweetness on the desert air". What an amount of wealth might be going into waste, might be guessed when we learn that the honey production of the United States of America is close upon two hundred million pounds, worth more than 5 crores of rupees.

Will Bee-Keeping be successful in India? I have no doubt it will. But, I think, we shall have to modify it a little. For the plains, at least, I think we shall have to design a hive that will give the bees more ventilation than is provided for in European or American hives.

What are likely to be the profits in Bee-Keeping? Well, I have not yet got figures for this country. In America, where material and labour are expensive and honey very cheap, it is estimated on a conservative basis, that on the average a profit of 15 rupees per colony per annum, could be realised. On this basis 200 colonies, which one man can manage without any assistance, would produce a yearly income of 3,000 rupees by no means a contemptible amount.

One great advantage of Bee-Keeping is, that it could be started in a small way with very little capital—about 50 or 60 rupees—and the business could be rapidly built up, making the bees “paying their way”. Another great advantage is, that Bee-Keeping may be taken up as a minor industry. I suppose we do not mind adding a little to our income; at any rate, I speak for myself.

BOOKS ON BEES.

No insect has so much literature devoted to it as the honey bee. Two of the very best books on bees in the English language are: (1) “A. B. C. & X. Y. Z. of Bee-Culture” published the A. I. Root Company, Medina, Ohio, U. S. A., price one dollar and fifty cents. (2) “British Bee-Keeper’s Guide Book” to be had of 8, Henrietta Street, London, price one shilling and six pence.

"THE GOLD STANDARD IN INDIA"

BY KUNJA BEHARY BULLAV, ESQ., M.A., B.L.

Munsiff, Khatra, Bankura, Bengal.

1. The essential characteristics of money are that it is the standard of value and that it is the medium of exchange. So far as money serves the purpose of a standard of value, it must be made of a substance stable in value. So far as money discharges the function of a medium of exchange, it is called the currency. Prior to June 1893, the rupee was the standard of value and the currency in India ; and the gold value of the rupee depended on the amount of silver bullion contained in it. The mints were then open to free coinage of silver. Anybody could take silver bullion to the mints and have the same coined into rupees. Consequently there could not have been any difference between the gold value of the rupee and the gold value of the silver bullion contained in the rupee.

2. Up to 1873 the ratio between gold and silver remained the same. From 1874 the gold value of silver began to decline. At this time the Latin union (France, Belgium, Italy, Switzerland and Greece) demonetised silver. In 1875 the average price of silver per ounce was $57\frac{1}{2}d.$, in 1876 it fell to $50d.$, in 1888 to $42d.$, in 1894 to $28d.$, and on 25th September last the price of an ounce of silver was $24\frac{1}{2}d.$ only. Consequently the gold value of the rupee (*i.e.*, the sterling rate of exchange) began to decline also. In 1873 the rate of exchange was

22·351*d.* per rupee, in 1880 it fell to 19·956*d.*, in 1885 to 18·254*d.*, in 1890 to 18·089*d.* and in 1892 to 14·985*d.* per rupee.

3. The fall in the value of silver showed it could not be relied on as the basis for the Indian money; for money, the standard of value, must be made of a substance stable in value. The consequences of this fall in the gold value of silver became very serious in India. The trade with the gold-using countries became disorganised on account of uncertainty in the rate of exchange due to fluctuations in the price of silver. Nobody importing £10,000 worth of cotton goods could say what would be its equivalent in rupees at the time of sale. Similarly the exporters of Indian commodities could scarcely calculate with certainty the price at which they could sell with profit in the west. This uncertainty in the exchange was a great drawback to importation of foreign capital in India, and without the aid of foreign capital, her material resources could not be developed.

4. India was threatened with great economic drain. Supposing prices to have remained at the same level both in Europe and in India as in 1873 when the rate of exchange was 2*s.* per rupee say (*i. e.* Rs. 10 per sovereign), 2 maunds of wheat valued at Rs. 5 per maund would have enabled an Indian in 1873 to purchase one sovereign worth of European goods. But in 1893 Rs. 10 could exchange for about 10*s.* only (the gold value of silver having fallen in the interval), and so an Indian could get only half a sovereign worth of European goods in 1893 for the same quantity of wheat. In other words as silver began to fall and the exchange began to decline, we had to part with more

and more of our goods to get the same quantity of European articles. When we wanted cash for our goods, we used to get the price in silver, a depreciated and depreciating article in Europe. We could have got a large quantity of silver by this means, no doubt, but silver would not have enabled us to stand on an equal footing with the gold-using countries of the west. If India had to remit cash ever for western articles, she could have got the necessary gold only by selling her silver at a great sacrifice. As a matter of fact India imports large quantities of silver every year. India is doing this from time immemorial. This is simply for the reason that while other countries want Indian goods, India has not an equal demand for foreign articles; and so she sells part of her goods for cash. The fall in the value of silver therefore greatly reduced our financial position in comparison with gold currency countries; and had silver been kept as the basis of our money, this lowering of our position would have gone on indefinitely.

5. Difficulty of the Government. The Government of India was also beset with great difficulty on account of the fall in the gold value of silver. The Government has to remit annually a certain amount for the expenses of the Secretary of State in London and this amount must be paid in gold. The amount has varied from time to time; and in 1893 it was about 16 millions pounds and at present is about 18 millions. "This expenditure in England is on account of interest on so much of the public debt as was borrowed in England; in payment of interest and annuities on account of railways purchased by the Government from the guaranteed companies; on account of stores, arms, and materials of all kinds for the

public departments; on account of charges incurred in England for the British force in India; and on account of pensions to retired public servants and soldiers." "About $\frac{2}{3}$ of this expenditure consists of payments on account of capital supplied by England and belong to a commercial rather than an administrative class of transactions, and the balance is a necessary concomitant of the British administration, to which India owes her material prosperity." That this expenditure is no drain is evidenced by the present flourishing state of the Indian finance and commerce. 'Drain' means the way to death and the signs would be decay of population and commerce, showing diminished power of production and purchase of the people. But that this not what we see on all sides. Everywhere there are signs of life and activity. We see exports and imports rising by leaps and bounds, and gold and silver streaming into India. "Within her own borders, there has arisen a great cotton spinning and weaving industry, which already competes favourably with European manufactures in eastern markets, and a great jute industry of a highly profitable kind; there has grown up a great and rapidly increasing production of Indian coal and petroleum oils; at the same time, new and valuable agricultural staples have been naturalised in the country. Iron works and the production of metals on a large scale have hitherto been delayed from various causes, but a large enterprise is now in course of inception with prospects of success." About 40,000 miles of rail-road have been opened already and irrigation canals are making fast progress.

6. [The mode of remitting the Home charges]. The revenue of the Government of India is realised in silver, and to remit the Home charges one would suppose silver rupees are shipped to London, melted and sold there.

That evidently means a great loss and that is not the method resorted to. The international trade is essentially a barter system. A country pays for its imports by its exports, and only the balance is remitted to it or remitted by it. In the case of India, her exports are generally in excess of her imports, and so cash has to be remitted to India to the extent of her surplus exports. Thus we see while the Government of India has to remit about 18 million pounds to the Secretary of State, the banks in London have to remit to India the price of surplus exports on behalf of merchants. So the obvious course is for the London bankers to pay the gold to the Secretary of State, and to take out the equivalent rupees from the Government in India. This is what is actually done. The Secretary of State sells in London every Wednesday Bills on Calcutta, Bombay and Madras, which are bought up by bankers and merchants in gold. They pay the gold in England and take out the rupees in India. But for how much of a sovereign is the Secretary of State to sell a rupee? Here comes in the exchange question. As the gold value of silver began to fall, the exchange began to decline also, and the Secretary of State began to get less and less gold for the same number of rupees. But the liability of the Secretary of State is fixed in gold. He must get the necessary gold and the consequence was the Government of India had to supply more and more rupees to meet the requirements of the Secretary of State. "The fall in the gold value of the rupee was therefore a source of increasing embarrassment to the finances of India. It occasioned unexpected deficits, obliged the Government to retain and sometimes to increase taxation which it was anxious to remit, to stint expenditure of the most necessary kind, to restrict public works, and to refrain from undertaking much required improvements by means of borrowed

capital, both on account of the apprehensions of the money-market and the risk of contracting fresh gold obligations." It is needless to add that the gradual depreciation of silver would have introduced a great disturbing element in all fixed monetary relations within India herself.

7. [First stage of the currency policy: To dissociate the rupee from the silver and to raise its gold value to 1s. 4d.]. Such was the situation before June 1893. The Government wanted to fix the price of silver by international agreement and a Conference met for this purpose at Brussels in 1892, but to no effect. Meanwhile the Sherman Act was being repealed in the United States and by this Act the Treasury had to buy $4\frac{1}{2}$ million ounces of silver monthly. There was fear of a great fall in the price of silver. The Government of India wanted to give up silver as the basis for the Indian Money. They wanted also to raise the value of the rupee. In 1873 a rupee was worth 22·351*d.* In 1892 it has fallen to 14·985*d.* To counteract the effect of this fall and to obviate the effect of the fall in gold prices in Europe, the Government wanted to fix the value of the rupee at 1s. 4*d.* To dissociate the rupee from the silver, the mints were closed to unrestricted coinage of silver in June 1893, as otherwise the gold value of the rupee would be the value of the bullion contained in it. But how to raise the value of the rupee to 1s. 4*d.*? The Government acted on the principle that the exchange value of the rupee would depend on the number of rupees in circulation and they wanted to force up the exchange simply by limiting the supply of rupees. For this purpose, no rupee was coined from June 1893 to 1900, when the exchange rose to 1s. 4*d.* and the demands of trade warranted coinage of new rupees. At the same time the Secretary of State would not sell his bills below 1s. 3½*d.* at first; It was notified also that the Government would

receive (a) gold coin and gold bullion at the mints in exchange for rupees at 1s. 4d. per rupee, (b) would receive sovereigns and half sovereigns in payment of Government dues at 15 rupees for a sovereign and 7½ rupees for a half-sovereign, (c) would issue currency notes in Calcutta or Bombay in exchange for gold coin or gold bullion at the rate of one rupee for 1s. 4d. It would be seen therefore that although gold was not made legal tender, the object of the Government was to acquire gold so that they might not have to sell rupees in unfavourable times. The ultimate object of the Government is thorough introduction of the gold standard so that there may be sufficient gold in the country to make international payments, whenever necessary. The result of this policy was not apparent immediately. The exchange stood at 1s. 2½d. before 26th June 1893 ; it fell to 1s. ½d. in January 1895. But since then the exchange rose steadily and from 1899 the rate is steady at 1s. 4d.

8. [The Second stage of the Currency policy: (a) supply of the currency and (b) maintenance of the standard]. After the closing of the mints in June 1893, the only source of supply of the currency in India was by cashing the telegraphic transfers or bills of the Secretary of State or by importing gold and taking out currency notes or rupees from the Currency office. As regards the currency notes it is well-known that they are issued against rupees (and partly against gold also) except to the extent of 14 crores (as fixed by a law passed in last March,) against which no specie is kept in reserve. These notes to the extent of 14 crores are put into circulation by purchasing Government securities. It is well-known also that about one-third ought to be kept in specie against the total amount of currency notes in circulation. But it was found in April 1900 that the silver reserve had fallen down to the small sum of

Rs. 3·7 crores only, while the gold reserve had reached the figure of 7½ million pounds. The amount of currency notes in circulation was then about 20 crores. The need for coining rupees became apparent, but the difficulty arose as to the principle on which the coinage was to have been resumed. The whole monetary system in India had become an artificial one and critics were not wanting, foreboding ruin and disaster following in the wake of "tampering with the currency of a great people." But the principle the Government adopted was to follow nature. Were the mints open, rupees would have been coined when that were necessary to meet the demand of the trade, the best index of which is the amount of the silver reserve in the Paper Currency Department. The Government has resumed coinage to meet the requirements of the trade only. The following table would show the coinage of rupees at the Indian Mints.

Year.	Rupees coined in crores.
1893—94	4·14
1894—95	nil
1895—96	nil
1896—97	nil
1897—98	·49
1898—99	·42
1899—1900	1·30
1900—01	17·15
1901—02	4·95
1902—03	11·27
1903—04	16·17
1904—05	10·88
1905—06	19·60
1906—07	25·37
1907—08	17·32
1908—09	2·51
1909—10	2·08
1910—11	2·20

9. [High Prices]. It is sometimes said there have been excessive coinage of rupees and this has led to the rise in prices. But the test of excessive coinage is depreciation of the rupee with respect to gold, *i.e.*, a sovereign would be exchanged for more than Rs. 15, but that is not the case. The small cultivators in the mofussil will take neither gold nor currency notes. What they want for their goods is silver rupees. Consequently large quantities of rupees are taken into the interior from head-quarters every year for purchase of exportable articles. But part of it only returns to the head-quarters in the shape of revenue and in the shape of price of imported articles sold in the interior. The balance is either used up in supplying currency in the interior or is hoarded or is used by local money-lenders to finance the local trades. Fresh coinage of rupees is therefore necessary every year to supply the currency to the trade, and as the Government coins rupees to meet trade demands, they do what is absolutely necessary. If prices rise even after adoption of this proper course, that is a healthy sign. For mere coinage of rupees cannot enhance the prices. The rupees must go into circulation. But the people must have to *purchase* the rupees with their goods, and absorption of rupees this way shows only the prosperity of the people. It would have been wrong, had the Government coined the rupees when not wanted by the trade and forced the same into circulation (by depositing the same with banks, say). In that case of course the rate of interest in the money market would have been easier and speculation stimulated, leading to high artificial prices. But that is not the case in India. The Finance Minister has accounted for the high prices in the following way: "Many causes may have contributed. There has been a rise in gold prices in the world generally. Increased facilities of transport in India have steadied prices

and probably raised their general level. Exports of produce may in some cases have raised the home prices of the same or similar produce. Abnormal prices realised for exported jute brought extraordinary gains to the Bengal jute districts. The influx of capital for the development of the country, industrially and commercially, has tended to raise prices. In 1907-08 the widespread failure of crops raised prices, particularly in Northern India."

10. [Supply of gold currency]. Now that the rupee has reached the desired level of 1s. 4d., sovereigns and half-sovereigns were made legal tender in September 1899. By the introduction of this measure, the gold standard was really introduced in India (although gold is not yet coined in India) and the rupee has become token money, being 1/15th of a sovereign. The object of the Government is that there may be a large stock of gold available in the country, so that international obligations may be met in gold. It is satisfactory to see that gold coins are increasing in circulation in the country and gold bullion is taking the place of hoarded rupees. The Finance Minister remarked as follows in March last in introducing the budget: "A remarkable feature of our trade requirements this year has been the striking economy in the use of our rupees. In previous years when our exports were being financed by heavy Council drawings and imports of sovereigns, the absorption of rupees was correspondingly high. In the last three years of normal exchange, for example, *viz.*, 1905, 1906 and 1909, the net loss of rupees from our currency Reserve between April and December was 10 crores, 13 crores, and 9 crores respectively. Between April and December 1910, so far from there being a large absorption, there has actually been a small net return of rupees from circulation. This entire reversal of the usual order of things has left us in an infinitely stronger

silver position than the ordinary student of our financial system could ever have anticipated; and I fear that it has been a grievous disappointment to those interests in the market which calculated on the Government of India being speedily compelled to resume the coinage of rupees on an extensive scale. Closely associated with this unexpected strength in our currency reserve are two other notable features. The first is the relatively small import of sovereigns as compared with the gold bullion which has been coming into this country. During the first 9 months of the year the total import of gold in all forms was close on £10 millions in value, out of which less than £3 millions were in coin. Under conditions which we had come to regard as normal, virtually the whole of these £3 millions would have been presented at our currency offices and treasuries, and exchanged for rupees. As a fact, the greater share of it does not appear to have come to us either directly or indirectly; and it is believed to have passed straight into consumption. Combining this with the heavy absorption of gold bullion, I think we may assume that a change, slow it may be but of no small economic moment, is coming over the savings of the people. It is unsafe to speculate how far the coined gold which we import is working into active circulation; but that a large quantity of hitherto inert silver currency has been brought into use during the last year or so, seems incontestable, and to that extent the necessity for further additions to our coinage from new silver has been averted."

11. [Second stage continued: maintenance of the standard]. This means steps should be taken so that the rupee does not fall below 1s. 4d. (*i. e.*, a sovereign does not become worth more than Rs. 15) or that the rupee does not rise above 1s. 4d. In other words what is wanted is fixity of exchange so that the rupee can always be

exchanged for 1s. 4d. or a sovereign for Rs. 15. To ensure conversion of gold into rupees, there is the provision that in currency offices gold will be taken at 1s. 4d. per rupee. But experience showed that sometimes the silver portion of the currency reserve went very much down in comparison with the notes in circulation and so a separate reserve of rupees had to be kept. Again although the Government has not undertaken unconditionally the obligation of supplying gold for rupees at 1s. 4d., yet the Government must have a stock of gold to keep the exchange at 1s. 4d. When the rupee has the tendency to fall below 1s. 4d. the Government must come forward to sell rupees at 1s. 4d. to keep up the exchange. At first the idea was that the exchange could be kept steady at 1s. 4d., if when the rupee tends to fall, the Secretary of State could stop his drawings *i. e.* does not offer rupees for sale. With this view, the Government of India is acquiring gold since 1893. In the first place by the Gold Notes Acts of 1898 and 1900, power was taken to keep a portion of the currency reserve in gold and that the gold may be located in London. By this means, the Secretary of State, when necessary, instead of selling bills in open market, can draw out the necessary gold from the Currency Chest in London and the corresponding number of rupees can be put into the Currency reserve in India from the Government Treasuries. Secondly, the Government is building up a stock of gold with the profits of the rupee coinage and with a part of these profits rupees are kept in the reserve also. It is called the Gold Standard Reserve. It has been built up with the profits of the rupee coinage. It consists partly of silver and largely of gold or gold securities. The silver portion of the reserve (which is kept in India) ensures convertibility of a sovereign for Rs. 15. The gold portion

of the Reserve (which is kept in London) enables the Secretary of State to stop selling bills in times of falling exchange and also enables the Government to sell sterling bills on the Secretary of State to steady up exchange in such a time. The composition of the Gold Standard Reserve on 31st August 1911 was as follows:

1. Rupees in India at £1=Rs. 15	1,934,302
2. Cash placed by the Secretary of State at short notice	... 1,167,616
3. Gold Securities	... 16,357,143
<hr/>	
Total	... 19,459,061

Recently the Finance Minister stated "It is not our intention at present to make any further reduction in the silver branch of the Gold Standard Reserve and it is not our intention to discontinue the silver branch."

12. [American crisis and Government sale of bills in London]. From 1893 to 1907, the currency policy received no shock on account of demand for gold. The exchange kept steady and the limit of the Gold Standard Reserve was regarded as a stock of gold sufficient to meet the requirements of the Secretary of State. But in 1907 a new phenomenon occurred. On account of famine in that year, exports fell off and a great financial crisis developed in the United States in October of that year. As usual, there was great demand for gold for America and the rate of interest in London rose sharply. In November the Bank of England raised its rate to 7 p. c., a rate unknown since 1873. In India the exchange fell to 1s. 32-9/32*d.* on 6th November (1907) and on 25th November it fell to 1s. 3-11/16*d.* It should be remembered that 1s. 3-27/32*d.* is the specie point *i.e.*, a figure at which it is profitable to export gold from India, provided gold can be got at Rs. 15 per sovereign. The Secretary of

State stopped his drawings for five weeks and in November and December he took out £2½ millions from the Currency Chest in London. It was decided then to sell sterling bills in London at 1s. 3·29/32*d.*, and the Government of India sold bills to the amount of £8,058,000 during the five months, April to August 1908, when the exchange again became normal. The result of the strain was that "in London the sovereigns in the Currency Chest were reduced from £7 millions to £1½ millions; Reserve securities to the value of £8,100,497 were put on the market; and all interest on investments was paid away as it accrued. In India the entire stock of gold was exhausted." But in the year 1909-10, export as usual went up and again there was great demand for rupees and the Government succeeded in recovering the gold it lost from the Currency Reserve and from the Gold Standard Reserve. The lessons of 1907-08 are that the Government should have sufficient stock of gold not only to meet the requirements of the Secretary of State but also to meet the trade demand for gold in times of excess of imports and falling exchange. In 1907 it was decided before the difficulty arose in that year, to devote one-half of the profits of the rupee coinage to capital expenditure on the development of the Indian Railways; but it was decided in 1910 in light of the experience gained in 1907-1908 "to discontinue this diversion and to pay the whole of the profits on coinage, together with the interest accruing on investments, without reservation into the Gold Standard Reserve until such time as the gold held in that Reserve and in the Paper Currency Reserve combined reaches the figure of £25 millions sterling". It is an accepted principle now that the Secretary of State is to sell bills freely to meet the requirements of the trade, irrespective of his own requirements.

13. [Conclusion.] These are the principal features of the Indian Currency policy. Never was any measure adopted more in the interests of India. It is true, holders of silver suffered some loss in 1893. But the fixity of exchange has led among other causes to a heavy growth in the commerce of the country. Although our exports have not been affected, India is gaining so to speak 33 crores of rupees a year on the import side. For, if the gold standard was not adopted, there is no doubt that the exchange would have fallen to at least 1s. per rupee or Rs. 20 per sovereign. In that case we would have had to pay Rs. 20 for each sovereign worth of European goods. But the exchange being at 1s. 4d., we have paid Rs. 15 for that. We have imported from 1900 on an average 100 crores rupees worth of goods or goods worth £100/15 crores. So an yearly average saving from 1900 is $(100/15 \times 5)$ rupees or about 33 crores a year, Rs. 5 being the saving on goods worth a sovereign. Similarly in their remittances to the Secretary of State the Government of India has gained Rs. 5 per sovereign, so to say. Sir David Barbour guessed the gain of the Government to be 70 or 80 millions sterling. But the best way of viewing the currency policy is that it is a permanently beneficial reform, intended to place India in her monetary and currency matters on an equal footing with the western countries, so that none can drain her on account of her depreciated currency but that she may acquire and retain gold to facilitate her transactions in the western markets.

INDIA AND IMPERIAL PREFERENCE.

BY PROFESSOR V. G. KALE, M.A.

(Fergusson College, Poona).

For obvious reasons India has not occupied in the British imagination the same place as the self-governing and other colonies have done. The average Britisher's ignorance about this country is proverbial though natural. India has long been commonly regarded as a convenient field for exercising the administrative and the military talent of the British race and the prospect of developing its rich and untapped natural resources has been held out as a temptation to lure public attention to it. The strategical position of this 'pivot of the Empire', its enormous trade potentialities and its teeming millions, its ancient civilisation and superior spiritualism have often been advanced as her claims upon the regard of the stay-at-home Englishman, the Imperialist and the Colonist. The interest evinced by the people of Great Britain and the Colonies, absorbed in their own problems, could not but be languid with regard to Indian questions and the sense of Parliament's responsibility in the matter of the proper governance of this country is easily satisfied by the conviction that in the hands of the Secretary of State and the Government of India everything must here be quite right. This attitude is, however, happily undergoing a slow but sure modification and of the factors which have contributed to shape this desirable tendency none is so important as the personal interest which His Imperial Majesty King George V., like his august father, has taken in the progress and welfare of this dependency. Their Majesties' visit to India, their presence among its many millions and the proclamation of their Coronation by His

Majesty's word of mouth, constitute an unprecedented honor such as has never been done to any other part of the Empire over seas. This unique distinction shown to India on the one hand and the spontaneous outburst of loyalty to the British throne and the British Empire which the event has evoked among Indian people on the other, ought to bring home to the mind of the British race the fact that India ought to be accorded no inconsiderable position in the British Empire. The eyes of the whole Empire and of the world are at present turned to this most essential member of that glorious organization and the auspicious event which has been celebrated throughout the length and breadth of this country, ought to cement still more strongly, the dependency to the Empire. The final goal of the Indian people is, in due time, to be able to obtain all the rights of British citizenship and to give their land its proper rank among the self-governing dominions of the Empire.

As has been said above, for obvious reasons, this rank has been denied to India and her direct voice has never been heard in the Councils of the Empire. The two political parties in England do what they think wise or expedient on behalf of their country without taking into confidence the best exponents of Indian public opinion. While the Reciprocity Agreement question was being fought out in Canada, the Liberal Government, however it might bless the measure, had to remain a silent spectator of the game, and Sir Wilfrid's party which represented liberalism in the Dominions, was defeated before its eyes. But the two parties can impose their political and economic doctrines on India without let or hindrance. While the Liberals are in power, free trade must be the dominating note of our economic fiscal policy, and we shall have to submit to preferential tariffs

when the Conservatives secure the reins of Imperial Government. Imperial Preference has, for some time past, been the chief plank in the Unionist programme, and though it will now be overshadowed by Home Rule and the Upper Chamber questions, fiscal reform must continue to engage public attention in Great Britain and the Colonies, the latter having already made considerable advance in that behalf. The recent events in Canada indicate the triumph, though temporary, of Imperial Preference and various schemes in connection therewith have been already discussed and propounded. Free traders, of course, do not believe in any beneficial effects of protective tariffs nor have they any faith in the unifying properties of Imperial Preference. During the last ten years the Imperial sentiment has become very strong in the Colonies which have shown their readiness to make concessions to and sacrifices for the mother country and for one another. The question is naturally asked, is the mother country to make no response to Colonial sentiment and offers of sacrifice? The present Liberal Government which was pleased to see Canada making a separate Tariff agreement with the U. S. A. as it harmonised with its economic doctrines irrespective of any considerations of Imperial Preference, had to yield to the pressure of Colonial feeling focussed at the last Conference so far as to appoint a committee to inquire how far the present fiscal relations of the members of the Empire with one another and with foreign states can be modified with advantage. This was intended as a mere sop to the Colonies and with it they have been for the time being satisfied. But in the case of India there is no need of doing even so much and free trade principles can here be applied in all their rigidity and nakedness. The apostles of free trade very pertinently twit the tariff reformers on the flagrant injustice they will have to do to India

if their scheme is ever carried into operation. Suppose, say they, Great Britain turns protectionist to-morrow, will they allow to India the same measure of protection as they seek for themselves? The question is unanswerable. Lancashire will not, even for a moment, tolerate the idea of its stuffs being taxed in India. Free traders, of course, avowedly believe that protection is bad in all its forms and that protective duties are mischievous. It is therefore quite in consonance with their theory that a counteracting excise duty should be levied on the mill-produced cotton fabrics in India, if they benefit by the import duty on foreign cloth. But British protectionists cannot consistently claim protection for their own industries and refuse it for those of India. An exponent of the British free trade policy recently wrote in answer to a tariff reformer :—

The policy of the Tariff Reform League, so far as it has been defined, means the admittance of British goods into India free of protective duties. The policy of Indian protectionists is to shut out British goods by prohibitive duties. The attempt to reconcile these policies is as futile as the attempt to square the circle.

Indian protectionists do not certainly want to make British goods a special object of their attack, though they are keenly desirous of encouraging their industries by means of import duties and otherwise. It is curious to note that the British tariff reformer is a protectionist at home and a free trader with reference to India. The position of the free trader is intelligible, not so that of the tariff reformer unless he is to be supposed to be animated by pure selfishness. If that is so, his vaunted Imperialism is a cloak to hide his interested motives. No wonder then that advocates of protection in India are suspicious of the blandishments of the tariff reformer and prefer his rival, the apostle of free imports.

For India unmitigated free trade is bad enough ; but there is strong reason to fear that Imperial Preference would be worse. The latter idea is based upon free or preferential trade within the Empire and high tariff walls against the protectionist world ; upon mutual concessions and sacrifices among the members of the Empire for the good of the whole. The common benefit, however, presupposes the benefit of the several constituent members. With every desire to do her part of the imperial compact India will insist, all things considered, upon the balance of the advantages which preferential tariffs are supposed to be capable of yielding, turning, however, slightly in her favour. If all British goods are admitted duty free into this country, foreign articles taxed, and commodities exported to non-British nations, subjected to a duty, what will be the gain of India that may be set off against the obvious loss ? The cotton excise duties may be removed and the revenue duties against the imports of Indian tea and tobacco may be taken off. This means a considerable loss of revenue on the one hand unaccompanied by any gain on the other. As things stand at present, on an average of the last five years, 64 per cent. of the import and 25·6 per cent. of the export trade of India falls to the share of the United Kingdom. The remaining 36 per cent. of the imports consist of articles which Great Britain cannot manufacture and no amount of concessions would create those manufactures there. As to the exports a similar remark may be made. The United Kingdom does not import more than 25 per cent. because it does not want more from India. While Great Britain exports more than thirty-five crores worth of cotton manufactures to India, Holland comes next with only half a crore and Germany and America are almost nowhere. Now, suppose the import duty of $3\frac{1}{2}$ per cent. is removed or abolish-

ed, what will England gain against her rivals? Nothing. India will only lose a crore and a half of her customs revenue, a pie of which she cannot afford to sacrifice in her present financial situation. Far from reducing our import duties we shall have to enhance them for revenue purposes as some of them have already been. We are told that the abolition of the import duty on British cotton manufactures will make clothing cheap in India. But how dearly will that cheapness be bought? The price will be loss in revenue and the ruin of the indigenous textile industry, the only substantial Indian industry in existence. If again, foreign articles which the United Kingdom cannot supply are subjected to heavier duties, they will be dearer to the consumer and thus the argument of cheapness falls to the ground. Of the export of Indian tea Great Britain takes a substantial share and the remission of the import duty in British ports is not likely to be of much advantage to us. An export duty on our raw materials, it is argued, taken by foreign countries will be productive of revenue and advantageous to Britain. Foreign nations cannot do without those goods, however burdened with duties. But as the Government of India remarked in their famous despatch of 1903 this will only involve us in tariff wars and foreign countries may very well retaliate upon us. Even granting that the export duties are levied upon foreign purchasers, as the Government of India might well do for purposes of revenue, it will only be an indirect gain to the United Kingdom. If Great Britain can offer us something worth bargaining for, then the proposals of tariff reformers may be seriously considered. So far as the schemes of preference that have been formulated are concerned they seem to be intended only to utilize India's raw materials to assail foreign rivals of England and to make the Indian market a monopoly for British

manufactures. The advantages that are put to the credit of India in the preference account are illusory while the items on the debit side are substantial. This is not business but juggling. Some advocates of preferential trade have frankly confessed that owing to India's peculiar economic conditions she does not stand to gain anything for many a year to come by such trade, but all the same they want to make this dependency a lever with which the United Kingdom is to recover the economic ground it has lost to her rivals. No shrewd man will make a bargain on these terms, nor will a fair-minded person have the hardihood to offer them. Our trade with the colonies and other dependencies is too small to be taken into account and mutual preference in their case will not affect the Indian situation in any way. To the United Kingdom the trade with the Colonies is important, as British exports to the self-governing colonies taken together are nearly 23 per cent. more than those to India.

So much about the business side of the question. As regards the sentiment involved in it, Indians have not been admitted to a partnership of the rights of the Empire, and therefore they cannot be blamed if no cord of enthusiasm is touched in their hearts by an appeal to Imperial sentiment. The blessings which British rule has conferred upon India are patent to every one and none are more conscious of and thankful for them than the Indians themselves. They have firm faith in the noble traditions and instincts of the British race and wish that the lofty ideal of British statesmanship that India ought to be governed in her own interests, should be translated into practical action. The attitude of the self-governing colonies towards India is not such as to foster any imperial fervour in the minds of its people and a change in this attitude is urgently required

if this dependency is to take its proper place in the comity of nations which constitute the British Empire. Even so circumstanced, India will not be unwilling to do her duty by the Empire and make sacrifices, as she has so often done in the past, if the other members make a reasonable advance. If the advocates of preferential trade within the Empire are really serious in doing justice to every member of it, let them allow India to retain her import duties on cotton manufactures for the protection of her indigenous industry and she will give preferential treatment to British goods. The schemes so far formulated are only one-sided and if there is no real reciprocity they will receive no favourable response in this country.

Opinions may differ as to the suitability or otherwise of a protectionist policy in India. Whether protection would be advisable in an industrially advanced nation like the United Kingdom and unwise in a backward country like India with her infant industries struggling for life, the demand for fiscal independence for this country is growing stronger every day. And neither the Government of India nor the people will acquiesce in a fiscal policy which holds out no substantial economic advantages to this country. The opinion of the educated Indians leans strongly towards protection. It believes that though free trade may be good for England it is not equally good for India. It appears, however, that a modified free-trade policy will be better for us than the sort of Imperial Preference which has been offered for our acceptance. The Indian Government wants the same fiscal liberty as the Canadian Government, for instance, enjoys and unless that is conceded India will not be in a position advantageously to join in schemes of Imperial Preference. The views of Prof.

H. B. Lees Smith in this connection are valuable, though we cannot subscribe to everything he says regarding Indian protectionism. He observes :—

“By preferential tariffs Great Britain will lose heavily in her Indian market. India, however, has little either to lose or gain from preferences themselves. Nevertheless, the proposals for preferences are of the highest importance to her. If they are ever adopted by the United Kingdom, they will undoubtedly be accompanied by a return to protection. India will then have a unique opportunity of gaining her fiscal freedom. Although I have not disguised my suspicions of the prevailing protectionist sentiment of India, I wish to see her freely adopting the fiscal policy which she considers most for the good of her own people. India, of course, means for this purpose the Indian Government, acting, I sincerely hope, in conjunction with the educated opinion of the country. My advice to the leaders of Indian opinion is simple. They should make it plain that if a preferential scheme is adopted, they are willing that India should have a place in it. One fact, however, must stand out clearly. Should Great Britain adopt protection she must honourably face the consequences of her conversion and allow to India the right to follow in her footsteps, if Indian administrators and thinkers consider it to be for the country's good.”

It is to be hoped that the visit of Their Majesties to this country will bring the British people to a frame of mind favourable to a correct appreciation of India's place in the Empire and their duty and responsibility towards its people. Only on this basis of fiscal freedom for India can a reasonable scheme of Imperial Preference be framed which will be conducive to the economic progress of this country and the greater solidarity of the British Empire.

THE ART OF ICE MANUFACTURE IN THEORY AND PRACTICE.

BY ALAKH DHARI, ESQ., PUNJAB TRANSPARENT ICE
FACTORY, AMBALA.

'The reduction of temperature of water and other liquids by the melting of saltpetre is said to have been known in India at a very remote period.'—A. J. WALLIS-TYLER, C.E., A.M.I.C.E., Author of *Refrigeration, Cold Storage and Ice-Making*.

'The artificial production of Ice cannot be claimed as a modern achievement. Ages ago, in India, water was frozen in shallow, porous earthen dishes, resting on some non-conducting material, as straw or grass, by being exposed to currents of air during the night.'—LOUIS M. SCHMIDT, PH. B., A.M.I.E.E., of LYNN, Massachusetts, U. S. A., Author of *Principles and Practice of Artificial Ice-Making and Refrigeration*.

CHAPTER I.

GENERAL PRINCIPLES AND METHODS OF APPLICATION.

HISTORICAL.

The principles of Ice manufacture were not unknown to the ancients, whether in India or in other parts of the world. The abstraction of heat by such means as the exposure of substances to be cooled to currents of cold air, or by the indirect agency of saltpetre, was a common knowledge among the Indians in olden days. In Europe, too, wine bottles are said to have been cooled in Rome 2,000 years ago by immersion in water cooled by throwing in of quantities of saltpetre. Orosius mentions that cold was artificially produced among the Esthonians about 400 A. D. for freezing the dead and the reduction of temperature of liquids. Later on, Latinus Tancredus, of Naples, mentions that in 1607 water was frozen among the Italians by the use of a mixture of snow and saltpetre.

But it would, probably, be quite safe to assume that the broad principles of the production of cold by artificial means were alone known in early times and that, in practice, ice-making or refrigeration was restricted to very small proportions up to within the last fifty-years or so. It is during this short space of time that improved systems of machinery have enabled the production of Ice and cold storage accommodation as cheap articles of commerce and everyday use.

PROPERTIES OF ICE.

The specific gravity of Ice made from de-aerated water is .926. Its specific heat is .504. At a temperature of 32°, Fahr., 1 cubic foot of Ice weighs 57.625 lbs. The equivalent of a ton of Ice is 318,080 British Thermal Units,* that is to say, this is the amount of heat that would be required to convert one ton of Ice at a temperature of 32° deg. F., into a ton of water at 32 deg., or, on the other hand, it is necessary to extract 318,080 Units of heat from one ton of water at 32 deg. Fahr., in order to convert it into one ton of Ice at 32 deg. Fahr.

PROCESSES OF MANUFACTURE.

In view of the great industrial importance attained by refrigeration and ice-making of late years, it is not surprising to find that many scientists and engineers are devoting their entire energies to the task of designing machines that combine efficiency in amount and quality of work performed with cheapness in price. A large number of different types of machinery, of varying degrees of reliability and satisfaction, has consequently been put on the market.

There are in the main two entirely different processes of Ice manufacture in use at present. One of them is known

* The amount of heat required to raise one pound of water when at 39.4 deg. one degree in temperature by the Fahrenheit scale is one heat (thermal) Unit. It is equivalent to 778 foot pounds of work,

as the Air-Expansion process, but owing, perhaps, to a low standard of efficiency, it is but little employed in the machines worked on a commercial basis. The other system is known as the Evaporation process. Machines of this class are, again, divided into two sections:—

(a).—Absorption system.

(b).—Compression system.

ABSORPTION SYSTEM.

In machines of the Absorption system, the refrigerating agent in a liquid state is placed in a generator and on being heated by means of steam is driven-off into a condenser, where it cools and is liquefied. From here it is allowed to escape into an evaporator, whence it evaporates back in gaseous form, and, in so doing, produces cold in the objects surrounding the evaporator. The evaporated gas then passes into an absorber and at the same time the liquor in the generator from which the refrigerating agent is driven-off, called "weak liquor," is allowed to escape slowly into the absorber, which is kept cool, and there it meets the gas coming from the evaporator and absorbs it. A strong solution of the refrigerating liquor is thus formed and it is pumped back into the generator to be re-heated and used over again.

In practice, numerous additions are made to the above process with the object of increasing the efficiency of the apparatus used. The evaporated gas, before entering the condenser, is passed through an analyser and rectifier, where the water vapour is condensed. A heat exchanger or economiser is provided for cooling the weak liquor, prior to its entrance into the absorber, and at the same time heat the strong liquor before it enters the generator. The evaporator may either be of the shell or of the continuous pipe coil type. In this, the heat is abstracted from the surrounding brine or other substance by evaporation of the refrigerating agent.

There are only a few Absorption machines now in the market. Indeed, the only firm now making this type of

machinery that I know of are Ransomes and Rapier, of London. I am indebted to them for the details of the above description of the Absorption process. There are some other types of early Absorption machines still in use, but it seems this system is fast falling into decay. The field is being wholly taken up by the Compression system, which alone can, in fact, now be regarded as the standard one adapted for industrial purposes in India.

COMPRESSION SYSTEM.

The principal features of machines working on the Compression system briefly consist in compressing the refrigerating agent (hereinafter referred to as the agent) in a force pump, commonly known as compressor, to a high pressure and then conveying this compressed gas to a condenser, where it is brought into indirect contact with fresh water which abstracts the heat developed by the gas during the process of compression and liquefies it. An intermediate apparatus, called the oil interceptor, is often used to trap and retain the particles of lubricating oil which are constantly discharged with gas from the compressor. The said agent is then passed into expansion coils, where it evaporates and in doing so abstracts from the surrounding substances (water, brine or air) practically the same amount of heat that was previously given up to the water in condensing. It is then re-compressed and the same cycle is repeated (without any loss of the refrigerating agent save that due to occasional leakage through defective joints) until the temperature of the water to be frozen is reduced below freezing point and solid cakes of commercial Ice are formed.

REFRIGERATING AGENTS.

Ice is manufactured through the agency of many agents capable of boiling and evaporation at very low temperatures, but Ammonia (NH_3), Ether— $(\text{C}_2 \text{H}_5)_2 \text{O}$ —, Carbonic Acid (C O_2) and Sulphurous Acid (S O_2) are the more popular and commonly used.

AMMONIA.

Anhydrous Ammonia (NH_3) is pure, dry, ammonia gas, almost free from water, compressed to a liquid state. NH_3 should be distinguished from the ordinary liquor Ammonia of commerce, which is a weak solution of ammonia gas dissolved in water, but anhydrous ammonia can be distilled, in case of necessity, from the said liquor through a simple distilling apparatus*.

Liquid Ammonia boils and vaporises at a temperature of about $88\cdot5^\circ$ below zero F., at atmospheric pressure. It has a latent heat of vaporisation of 900 and a vapour tension of about 108 lbs. per square inch at a temperature of 60 deg., Farh., rising by rapid degrees to about 150 lbs. pressure when at 77 deg., Farh. The liquefaction of gas, by pressure, above 77° F., is rendered difficult by reason of excessive strain on the compressing pump which is generally not made very strong. For liquefaction by cold, ammonia has to be reduced to a very low temperature, *viz.*, about $-85\cdot50$ F. It possesses great heat absorbing powers. Specific heat of NH_3 liquid is 1.228 by colorimeter test, in consequence of which the power required for driving an ammonia plant is much less in comparison with those wherein other refrigerating agents are used. Ammonia does not in any way corrode iron but exercises an

* NOTE :—The apparatus required for distilling ammonia from the ordinary liquor comprises a still, a condenser, separators and a dehydrator, all tested, when jointed together, to a pressure of about 100 lbs. per square inch. The still is heated to a temperature of about 212 deg. Farh., by insertion of a coil containing live steam, when gaseous ammonia passes, saturated with particles of water vapours, into a preliminary separator. In this separator, a large part of the watery particles is eliminated by falling thro' pipes provided with perforations for the purpose and returned through pipes to the still. The partially dried gas passes through a water cooled worm in the condenser and on into the dehydrator. Additional separators may be used to meet necessary requirements. In the dehydrator, freshly burnt lime is placed on plates in which the ammonia gas has to pass and which are perforated with a view to let the burnt lime suck whatever little of moisture remains in the gas,

injurious effect on copper. It is neither as explosive nor as inflammable as ether. Ammonia has a molecular weight of 17 and a density of 8.5. It is a colourless irrespirable gas having a strong pungent and easily recognisable odour. It is slightly combustible when mixed with air and burning feebly with a flame of greenish yellow hue. When mixed with about twice its volume of air, it is capable of exploding with violence. No part of ammonia apparatus should have a naked light inserted into it until it has been opened, exposed to and mixed with a large volume of air for a sufficient time to render the gas innocuous in presence of light. It irritates human organs when inhaled. The Spec. gravity of NH_3 liquid is .76 (water=1) and of vapour .59 (air=1).

ETHER.

Ether— $(\text{C}_2 \text{H}_5)_2 \text{O}$ —is a colourless liquid having a strong peculiar smell. It is lighter than (specific gravity, .723), and does not dissolve in water. The vapours of ether are about 37 times heavier than hydrogen and 2.586 times heavier than air. The boiling point of Ether is 84.97°F . Ether is highly inflammable and explodes with great violence when, escaping into air in vaporous condition, a naked light is brought near it. Its specific heat is 0.53 and as a refrigerating agent it has a much lower efficiency than ammonia. The low vapour tension of ether, though rendering it necessary to use, proportionately, a large quantity thereof to produce a given effect, has one great advantage, *viz.*, the comparative safety and simplicity of all working parts which is rendered possible owing to its low working pressure, and which is a great factor in a tropical country like India, where the average mechanic is not well versed in the intricate details and pitfalls of a complicated machinery. The efficiency of machines working on the ether process does not fall off in any marked degree when operated with condensing water at comparatively high initial temperatures ranging somewhere about 90°Farh. , while the small amount of pressure generated in the condenser, namely, from

7 to 15 lbs., per square inch, is favorable to the maintenance of joints in a tight condition and risks of leakages are rendered remote.

CO₂

Carbonic Anhydride (CO₂) is a substance which does not exercise any corrosive action on metals. It does not support combustion or human life but its fumes in case of escape in a well ventilated room are not much harmful. It is claimed by the pushful firm of J. & E. Hall that, under atmospheric pressure, CO₂ evaporates from the solid state at temperature of 120 deg. below zero Farh. From another source I learn that the evaporation begins at—78·2 F. Liquid CO₂ boils at 30 deg. Farh., at 35 atmospheres pressure. But, by regulating the pressure, it could be caused to boil at as low a temperature as 0° F. CO₂ has a molecular weight of 44 and a density of 22.

The specific gravity of liquid CO₂ is ·83, and its vapours are 1·5241 times heavier than air. It occurs free in the air but the commercial substance used in ice-making is a bye-product formed during the process of fermentation of cane juice. It is also obtained out of *choke dampe* of coal mines. There is one great disadvantage in the use of this agent in the tropical climate like India. With cooling water at the high temperatures available in this country, CO₂ requires a very high pressure for liquefaction, reaching to about 1,300 lbs. per square inch.

SO₂

Sulphurous Acid (SO₂) is an anhydrous, non-inflammable, gas. Its fumes, though irritating, are harmless, and unless excessively inhaled are not injurious to health. It is a powerful disinfectant. SO₂ liquefies in the condenser at a pressure varying from 30 to 50 lbs., according to the temperature of condensing water. It has a strong smell. Not only it does not corrode metals, but SO₂ also possesses certain useful lubricating properties, which enable the compressors

using this agent to dispense with other kinds of oil lubrication, and the difficulty of oil coated condenser and refrigerator tubes does not, therefore, exist in SO_2 machines. When mixed with moisture and air, it gets converted into sulphuric acid in which state it attacks iron in a bad way. The specific heat of liquid SO_2 is $\cdot 3178$. The specific gravity of SO_2 in gaseous state, is $2\cdot 211$ (air = 1) and in liquid condition, at 4 deg. F., = $1\cdot 491$ (water = 1). Its boiling point is $-10\cdot 08^\circ$ F.

STANDARDS FOR HEAT AND WEIGHT.

Mention has been made in this chapter about the terms specific heat, specific gravity and latent heat, etc., of certain substances and for the information of those who do not understand what such expressions signify, it may be well to explain these terms.

To start with, water is a liquid composed of hydrogen and oxygen in the proportion, by weight, of $88\cdot 9$ parts of oxygen to $11\cdot 1$ parts of hydrogen, and, by atoms in the molecule, of two atoms of hydrogen to one of oxygen. The chemical formula of water is, therefore, H^2O . At the ordinary atmospheric pressure of about $14\cdot 7$ lbs., per square in. water freezes to ice at 32 deg., F., and boils and is changed to steam at 212 deg., F., but under increased pressure, the boiling point may rise higher. The chemical composition of water does not change either by freezing or by boiling.

By specific heat is meant the amount of heat required to raise the temperature of a body one degree by the Fahrenheit scale as compared with the amount of heat required to raise an equal quantity of water one degree. The specific heat of substances varies according to whether they are in liquid, solid or gaseous conditions. The variations in temperature and pressure also alter the values of specific heat. Water is taken as a standard for specific heat and with the exception of hydrogen it has the greatest specific heat. By reason of its extreme rarity, hydrogen requires $8\cdot 409$ amount of heat to raise its temperature as compared with water = 1. The specific heat of air is $= 0\cdot 28751$ and of Ice $= 0\cdot 504$.

Specific gravity is the weight of a substance by volume as compared with the weight of an equal volume of water. Pure distilled water at the ordinary atmospheric pressure (14·7 lbs.) at a temperature of 39 deg., F., is taken as the unit of standard for all substances in liquid or solid state. The standard of specific gravity for gases is pure fresh air. At a temperature of 59 deg., F., distilled water is 819 times as heavy as air. The specific gravity in gaseous form of hydrogen is ·0692; of oxygen=1·1056; NH_3 =·59; $(\text{C}_2\text{H}_5)_2\text{O}$ = 2·586; SO_2 = 2·211; CO_2 =1·5241, when air=1.

Latent heat has been thus coincisely defined by Balfour Stewart: "Latent heat is the heat which is absorbed by bodies in passing from one state to another, but it does not manifest itself by producing an increase of temperature and is on this account called latent heat. A pound of water at 212 deg., F., mixed with one pound of water at 32 deg., F., gives 2 pounds of water at 122 deg., the mean of the two components; if, however, a pound of ice at 32 deg. be mixed with a pound of water at 212 deg., we have two pounds of water at 51 deg. only.....The difference being equal to that required to raise 2 lbs. of water through a range of 71 deg... ..representing the heat required to liquefy 1 lb. of ice." The latent heat of water for liquefaction at 32 deg. is 142·4, and for vaporization at 212 deg. 966, British Thermal Units.

INDUSTRIAL USES OF REFRIGERATION.

Refrigeration is used in many other manufacturing and industrial processes, a few of which are mentioned here. Freshly killed meat, eggs, milk, butter, fresh fruits and fish, &c., can all be kept in a state of preservation for long spaces of time when stored in rooms the temperature of which has been artificially lowered for the purpose.* In Europe, indeed, the principles of refrigeration are not so widely known by reason of their application to ice manufacture as owing to their use in abattoirs and cold

* See Table given in Appendix 'C' at the end of this treatise.

stores. In breweries, refrigeration is employed to furnish constant and easily regulated low temperatures in cellars and fermenting and settling rooms.

When live animals have to be transported for long distances by sea and have to pass through different climatic conditions, artificial cold comes to aid and, by keeping the holds containing those animals in uniform temperature, saves them from destruction. In recent times, however, the transportation of live cattle for slaughter from distant countries has been in a large part abandoned. Sea vessels are fitted with cold stores wherein meat can easily be carried in conditions of absolute freshness at, comparatively, cheaper cost.

Refrigeration is useful in dynamite factories for keeping the dynamite in a cold and tractable state during the processes of nitrating ; in the manufacture of photographic ware for cooling and consolidating the gelatine dry plates. In chemical works, it is of immense use for reduction of mother liquors to low temperatures, acceleration of crystallising processes and for production of a larger amount of crystals from the same quantity than could otherwise be obtained. In ocean-going vessels, cold storage machines are used for preservation of food products and for cooling of residential apartments when passing through tropical zones.

In India-rubber factories, and celluloid works, blocks are hardened and cured by application of cold, which enables their being cut and made into all the various articles of every day use, recreation and pleasure. Refrigerated India-rubber sheets are capable of being worked in a much superior manner and at a far lower cost than others not consolidated in this manner. In glue works, gelatine is hardened and dried through cold, which is also a most efficient medium for the preservation of furs and various fabrics such as woollen carpets and rugs, silks, tapestries and up-holstered furniture from ravages by insects and, in case of silk, to prevent it from losing weight and to preserve its gloss or lustre.

In skating rinks, the principles of artificial cold production

are applied for providing surfaces of Ice to admit of the excitement and sensation incidental to rapid slidings over smooth ice platforms being enjoyed in immune warm weathers. In parafine and oil works, refrigeration is employed in various processes of congealing, hardening or otherwise facilitating the methods of manufacture and storage. In paints works, vinegar factories, sugar refineries, chocolate manufacture, &c., refrigeration is, likewise, useful for solidification, heat abstraction and preservation of products before, during or after, the manufacturing processes.

CHAPTER II.

THE COMPRESSION SYSTEM.

GENERAL SURVEY.

As mentioned above, of all the methods employed in the manufacture of Ice, the one known as the compression system is most popular and by far the best adapted for production of cold or Ice on a commercial scale. Whatever the refrigerating agent, the cycle of operations is the same in all machines working on this system, *viz.*, the refrigerating agent is first evaporated, then compressed and, finally, condensed and liquefied for re-use.

REFRIGERATOR.

The evaporating apparatus, commonly known as Refrigerator, consists of a series of coils or pipes into which the refrigerating agent is admitted and which are surrounded by brine. The agent absorbs heat from this brine and in doing so gets vaporized itself. The powerful sucking action of the compressor pump keeps a state of vacuum in these coils. Besides drawing away the vaporized gas, this vacuous condition, by causing void, also helps in the actual vaporization of the agent.

Refrigerators are constructed in several different patterns.

(a)—In which the evaporating coils are contained in an independent, insulated, tank, wherein brine from ice-tank is

admitted at one end by means of a force pump and after parting with its heat to the agent and getting cooled itself, is pumped again into the ice-tank or arranged to flow thereto by mere force of gravitation, and made to circulate around ice moulds or in cells.

(b)—In which the evaporating coils are placed in a side or centre of the ice-tank itself and the circulation of brine is maintained by means of a mechanically worked propeller.

(c)—In which the evaporating coils are spread throughout the ice-tank. A row of ice moulds is alternately followed by one, or more, line of evaporating coils. This arrangement is known as the direct expansion method and is thought more economical than either of the above two processes. The cold is produced exactly where it is required and there is no loss or wastage-incidental to its transmission from a distance. A higher evaporating pressure can be maintained in direct expansion pipes without a corresponding enhancement in the temperature of the refrigerating agent contained in the same. The gas is sucked into the compressor at a high back pressure and a larger amount of efficiency is obtained.

There is yet another type of Refrigerator used in some other Ice machines. It may be called a multitubular Refrigerator. It consists of a velded copper cylindrical shell with hammered end plates into which reamless drawn brass or copper tubes are fitted. Ether is admitted into the hollow space around the tubes, through which brine is passed.

It may be noted that the types of Refrigerators described in (b) and (c) are applicable for can Ice tanks only. A cell Ice tank must, of necessity, have its Refrigerator fixed in a separate tank from which brine is forced through the cell-ends into the plates.

COMPRESSOR.

As soon as the agent has done its work of abstracting heat from the surrounding brine, it passes in a gaseous state into the Compressor, the function of which is to subject the gas to a pressure sufficient to reduce it, on being brought into

contact with fresh water, to a liquid form. During this compression a degree of heat is developed in proportion to the amount of pressure to which the gas is subjected and which pressure varies according to the detailed table given in Appendix A from—

7 to 17 lbs. per square inch	in case of Ether	
35 to 90 lbs.	" "	SO ₂
105 to 228 lbs.	" "	NH ₃
700 to 1338 lbs.	" "	CO ₂

This compressed heat the agent parts to fresh water in the condenser.

The Compressor is formed of a cylindrical vessel of cast iron (and in case of a CO₂ plant from forged steel) in which the gas evaporated from brine tank is pumped at one side and compressed and discharged into a system of pipe-coils called the Condenser at the other. The Compressor pumps are of two types, vertical and horizontal, but the principle of working is the same in both and each of them may be constructed for single action or double action. Single-acting Compressors are provided with two valves only, one at each extremity and known as suction valve and discharge valve, respectively. The suction valve draws the evaporated refrigerating agent from expansion coils and, after subjecting to the required pressure, discharges the compressed gas into the Condenser coils.

A single acting Compressor has the advantage, when working with a gas of the tenuity of Ammonia, of preventing the stuffing box through which the piston rod works and which, in this case, is generally situated on the suction side of the Compressor from being subjected to the high pressure of gas in a compressed state. The risks of leakage of the gas through this gland are thus comparatively less. A high pressure on the gland cannot, however, be avoided in a double acting Compressor, where one suction and one delivery valve is situated at each end of the cylinder and where the compressing pump, in being obliged to perform a double duty (suction at one end and delivery at the other) in every

single stroke, has naturally to put forth the same amount of pressure against gland in the return stroke as there is at the other end in the forward stroke. But a double-acting pump is advantageous from an economical standpoint, in as much as in a single stroke and with nearly the same amount of friction of all parts save in the stuffing box, a much large amount of gas is dealt with. The amount of friction engendered by extra tight packing in a double-acting cylinder gland is, however, not inconsiderable and many a maker of Ice machinery prefers to use single-acting pumps. Taking all matters into account, it is roughly estimated that there is a net saving of from 20 to 25% power in a double-acting machine.

In the vertical type of Compressors, the wear of the cylinder is proportioned equally on all sides and is comparatively very slight as the strain due to work and the weight of working parts is not borne on any one side in particular. But, in a double acting vertical Compressor, the discharge valve at the lower end, even if it is placed on a side, often gives much trouble as it permits of oil being discharged before all the gas has left the pump. This difficulty is sought to be overcome in many ways. In the De La Vergne type of vertical Compressor, for instance, there are two discharge valves on the side at lower end, one above the other. On the down stroke either of the valves, or both, get opened until the piston covers the upper one, when only the lower one is open to the Condenser. In the further course of the piston and as soon as the lower valve is also closed, the upper one is placed in communication with an annular chamber contained in the piston. This chamber has valves in its bottom, which open into it as soon as all other outlets from the lower side of the piston are closed (they open a little harder than the discharge valves on the side). The gas now goes out through the piston and oil follows after the gas. By this method, the makers claim that no gas remains on the lower side after completion of the down stroke.

In the horizontal type, the weight of the piston falls on one

(the lower) side only, which consequently shows signs of greater wear ; but it presents several practical advantages in the shape of tractability and facilities in control, which have tended to increase the horizontal type in public estimation and extended its use. The oil difficulty of the vertical type is unknown in this method. The different parts of the machine are placed in close proximity, which apart from the simplification of the apparatus admits of easy and constant attention and less exposed to the risk of accidents.

In the upward stroke, the piston of vertical machines has to reach right up to the inner surface of the top cover. Should the piston happen to get loose or a valve fall in the cylinder, the end cover stands in the danger of getting knocked off. To avoid this risk, some compressing machines are fitted with a false or safety head, which is of the same diameter as the cylinder and is fixed with spring seats. It is designed to come in metal to metal contact with piston face at the end of the latter's upward stroke. The known advantage of the safety head, besides reducing the clearance space to an absolute minimum, is the security it guarantees against the breaking of the end cover in case of accident to machinery or an overcharge of liquid oil, etc., in the Compressor. In such a case, the safety head recedes back from its seat and allows the obstruction to pass through. The shifting movement repeats itself and continues until the difficulty is removed, and prevents the destruction of the Compressor that would result if heads are fixed solid.

The valves in Compressor cylinder are always kept tight and held to their respective seats by means of suitable steel spring cushions. While weak springs are liable to create great havoc, too strong spring seats also cause an undue amount of pressure to raise the valves from their seats. An over powerful suction valve means the production of an excessive amount of suction to work it and an extra strong delivery valve will cause the expenditure of a proportionately greater power to raise it from its seat. In order to overcome such difficulties, indicator apparatus are sometimes fitted by

the aid of which the tension of compressor valves can be adjusted to a nicety.

To admit of Compressor being opened-up for examination and cleaning-up, etc., without loss of the refrigerating agent, it is fitted with two stop cocks, one each in suction and delivery pipes. The machines wherein the use of an agent, like CO₂, renders it necessary to work them at a very high pressure are fitted with a safety device consisting ordinarily of an ordinary spring valve having at the base a thin copper disc which is constructed weak and thin to burst up at a pressure much below that which a compressor can safely withstand. If a machine happens to be negligently started with the Compressor delivery valve shut, this safety device comes to rescue and prevents injury to the Compressor.

CONDENSER.

The third essential part of an Ice machine working on the compression process is a system of pipe coils into which the gas is next admitted and where the heat developed by the refrigerating agent during the compression stage is eliminated. The agent delivers its heat to the fresh water running around the pipes and is itself reduced to a liquid condition. The whole system of Ice manufacture is thus governed by the well-known law of physics, *viz.*, all gases during the process of passing from a liquid to a gaseous absorb a certain amount of heat, which is thrown off when they return from a gaseous to a liquid state.

The Condensers commonly in use are made in three different classes, *viz.*, the open-air evaporative, the submerged and the double-pipe.

The vaporized gas in all the three types generally passes in an opposite direction to that of the cooling water, so that the warm gas entering the condenser meets with warmer water and as it proceeds along and gets lessened in heat it comes in contact with cooler water, until at last when it is already very much weakened, the touch of fresh cold water running in from the opposite end completes its reduction to a liquid state.

In the open-air, or, as it is more commonly known, the atmospheric type, the coils through which the liquid agent passes are located in open space so as to admit of exposure to currents of fresh air and a small stream of cold fresh water is kept trickling over them. In many a type of Condenser of this class, warm gas is admitted at the bottom end and as fast as it gets condensed, it flows out by means of drip pipes provided at the side ends of coils, in different levels. Water is admitted at top and, in order to avoid it from spattering over in the downward course, strips of metal are attached to the underside of every pipe and they serve to guide and evenly distribute the flow over the tube next below. One half of the water, under this arrangement, passes on one side of the tube and the other half on the other side of the tube. Atmospheric Condensers are sometimes cooled by currents of air artificially produced by mechanical fans, but such an arrangement can hardly pay unless water has to be paid for at a dear rate and temperature of cooling water is high.

In the submerged type Condenser, coils containing gas are kept immersed in a water tank, wherein cooling water is admitted at bottom, near the exit of the liquefied gas. As water rushes it gradually gets warmer by absorption of heat from the agent, which is admitted at top and flows downwards. Submerged Condensers are convenient and handy by reason of the shorter space taken-up by them and the capability of their being located in any spare place in the building. The coils, too, remain clean and being prevented from exposure to air usually last longer. In some types, the water in condensing tank is kept in a constant state of agitation by a revolving paddle to break up the films which generally form themselves around the pipes. There is one great disadvantage in submerged Condensers, *viz.*, they require, comparatively, a much large quantity of water to do the same amount of work and prove an expensive luxury where water is scarce and costly.

Some makers have constructed a compound type of Condenser, which in some measure comprises the principles

and the good points of both the above two methods. The arrangement in this method consists of hot gas from Compressor being first passed through a single coil pipe at top. This coil is either exposed to air on the atmospheric Condenser principle, or, as in marine installations, submerged in a water tank. The water returning from the main Condenser is passed over this coil and, though somewhat warm, it is still sufficiently cool to extract some amount of heat from the hot gas and partly weaken it. The gas is then passed into a second, or the main, Condenser, which is usually of the submerged type. Fresh water, entering from the bottom, is applied here and the condensation process completed.

The double-pipe Condenser consists of a pipe, or series of pipes, made-up with one pipe inside another. Fresh water is admitted at the bottom end in the inner pipe while the hot gas enters at top in the annular space between the inner and the outer pipe. The hot gas travels in a downward direction and water in an upward direction, by means of which an interchange of temperature is effected and warm gas first comes in contact with warmer water. The upper section of outer pipes is sometimes made larger than the lower one, to provide more space when the agent is in a rarefied condition. The Condenser is often constructed in one or more nests, every one of which is independent of the other. It is claimed for this class of Condensers that they combine the best feature of both the above two classes. Some makers of the double-pipe Condenser claim that the liquid refrigerating agent as it runs out of the coils is reduced to within 1 per cent. of the temperature of circulating water and consequently a low pressure can be carried in the compressing pump, which, in other words, means an economy in power and fuel. An objection to the Condensers of this class would appear to lie in the liability of the deposit of scale inside the tubes from muddy waters.

AIR RELIEF VALVE.

An air relief valve is fitted to the Condenser coils to permit, when pressure in the system rises abnormally high, blowing off the air or accumulated foreign gases.

BY-PASS.

Ice machines are sometimes provided with an arrangement, known as by-pass, by means of which the refrigerating agent can be pumped direct from the Refrigerator to the Condenser and *vice versa*, or for exhausting the compressing pumps themselves before the heads are removed for examination. When a fresh charge of the refrigerating agent is desired to be given and a vacuum has to be produced in the Refrigerator, this by-pass arrangement is of considerable convenience in pumping the air out. By-pass valves remain shut when the machine is on regular duty.

OIL TRAP.

It is necessary to inject a supply of oil in Compressors for lubricating the cylinder and piston in order to reduce friction and fill-up clearance spaces between piston surface and discharge head. It may be claimed by many a maker that in his system a metal to metal working in the compressor can be achieved, but in actual practice more or less clearance spaces do remain and it is safer to fill them up with oil (injected primarily for lubrication purposes) than to allow the clearance space to remain filled with compressed gas, which will re-expand during return stroke of piston, and constitute a bar to the free working of the pump, caused by the pressure put on suction valve by expanded gas, and reduce its efficiency. Small particles of this oil pass out of the discharge valve at every stroke and in order to prevent them from entering the Condenser and by painting its inner surface reduce its efficiency, an arrangement is usually provided between the compressor and the Condenser for entrapping the said particles of oil. It consists in a screen of suitable mesh or a gas filter which retains the oil and passes out filtered gas. Automatic arrangements are provided for rectifying the oil and cocks and valves are fitted in the oil interceptor to admit of oil being removed while the machine is in operation or for delivering it again automatically in the Compressor cylinder.

LIQUID RECEIVER.

An apparatus is provided between Condenser and Refrigerator for receiving and storing the liquefied refrigerating agent. It is provided with a gauge glass for ascertaining the volume of liquid contained in it, as also with a fine screen to prevent any foreign substance from passing into the refrigerator coils. It is desirable to make this liquid receiver of ample capacity to hold, in the event of necessity, the entire quantity of the refrigerating agent charged in the machine without danger of explosion on account of the agent getting heated to the temperature of the atmosphere. When the receiver is not full of liquid, non-condensed gas may also pass along with the liquefied agent into expansion coils and not only interfere with the work being done there by the condensed part of the agent but also fill-up the very limited evaporating area with an useless substance. It is, therefore, advisable to see that this receiver is always kept pretty full with the liquid agent.

A gas relief valve may profitably be fixed in this apparatus and fitted with a pipe connection to allow the non-condensed gas escaping into the liquid receiver being redirected to the Condenser.

VALVES AND COCKS.

A large number of valves and cocks are used in an Ice machine and the efficiency of a machine in a large measure depends on their regular and true working. The more important of these valves are (a) the suction and the discharge valves in the Compressor, and (b) the expansion valve.

A notable type of suction valve is that made by the Triumph Ice Machine Company. The valve is made entirely of steel and fitted with a guard so designed as not to reduce the port area. The guard is attached to the lower end of valve stem which is enlarged for this purpose. Should this stem become broken or work loose, the guard prevents it from falling into the machine. By removing the caps fitted on the valves, which can be done while the machine

is in operation, the movement of valves can be observed and it may be ascertained whether they open and close at the proper periods and if the amount of lift is correct. Should the suction valve be found to become too tight, the lift could be adjusted to proper proportions by turning the stem a little to right. If the tension of springs has lessened and the valve opens too far the requisite regulation may be given by turning the stem to the left.

A convenient type of expansion valve used for regulating the flow of the liquid refrigerating agent into the expansion coils is the one operated by a worm gear. A wedge-shaped opening, coupled with worm gear, ensures the adjustment of discharge to minute details. In the type used in De La Vergne machines, the action of worm gear, which is worked by a wheel, is supplemented by making the valve tapered at one end.

CHAPTTR III.

ICE TANKS.

FOREWORD.

Ice is frozen in vessels of several different patterns, but only two of them are commonly made use of in India and they are known as (a) the can, and (b) the stationary cell systems.

CAN SYSTEM.

In the can system of Ice-making, water is filled in rectangular moulds made of galvanised iron sheets and having well-braced and rivetted top bands, soldered smooth inside, and having both in breadth and in thickness a slight taper downwards so as to facilitate the sliding out of the blocks of ice when moulds are thawed and turned upside down.

The cans are of different sizes, varying from 6" thick x 12" wide x 28" deep (holding a 50lbs. block of ice) to 40" x 48" x 9" which hold a 5 cwt. block of ice. A convenient size of Ice mould for India is one 36" deep and 30" x 7" at top tapering all round to about 28" x 6" near bottom, made from No. 16

B. W. G. galvanised wrought iron plain sheets and making a 2 cwt. block of ice. It would be better if bottoms are made from a somewhat thicker sheeting, say of No. 14 gauge. All joints to be rivetted about one inch apart and well soldered, on the inside, with lead. A strengthening flat bar, about $1\frac{1}{2}$ " \times $\frac{3}{8}$ ", may be fitted round the top rim and two semi-circular handles made from $\frac{1}{2}$ " round iron bar be fixed, one 6" away from the left hand end on one side and the other 6" away from the right end on the opposite side, for lifting them. The four sides should as far as possible, be made in two pieces only, each piece covering a full width surface and half section of end sides, to reduce the number of joints to a minimum and avoid risks of leakage.

Ice cans rest on wooden supports ; their bottoms remain usually about 6" above the floor of ice tank. The cans are surrounded on all the four sides and underneath by brine, which extracts heat from fresh water inside (iron being a ready heat conductor and delivers it to the refrigerating agent by causing evaporation of the same and, getting cooled itself, returns to the charge and by a series of interminable cycles succeeds in eventually freezing the water contained in cans solid. The ice tank itself is of wood, well-seasoned and from 2" to 4" in thickness (according to size of tank, lined sometimes with galvanised steel sheets on the inside and properly insulated with charcoal, wool, date-palm fibres, cork or other heat non-conducting material.

The lids used for can Ice tanks vary to a large degree in size and fashion. In some systems, which work on what is known as the continuous system, a separate lid is provided for each can, which also has a top-frame of its own, thus dividing the tank into as many small compartments as there are Ice cans in it. In other systems, the lids are large enough to cover several cans together and are made of 1" thick planks, laid double, one over the other, with 8" or 4" battens between them and this hollow space is sometimes filled with a light insulating material.

The brine cooling service is, as has already been explain-

ed at length in Chapter II, maintained in many different ways. The most common method is to spread the expansion coils in the Ice tank itself, underneath the Ice moulds and along side of them. But the refrigerator may as well be located in an independent tank and brine service between the Ice tank and the refrigerator kept up by means of a force pump, or, again, the expansion coils may be nested and put in a corner of the Ice tank and the brine circulated throughout the tank by the aid of a propeller.

The principal advantage in the manufacture of ice on can system is that the freezing proceeds from all sides of the walls of cans and it, therefore, takes a much smaller time to freeze a block of ice in cans than in the stationary cells. The outfit of the ice tank, too, is simple and involves less expenditure of initial cost. But the rapidity of freezing is obtained at a partial expense of quality and where a superior article is in demand, the stationary cell system is adopted.

CAN FILLER,

To avoid different cans in the same tank being filled with unequal quantities of water and the difficulty of fresh water over-flowing into the brine tank, an automatically working device is adopted, whereby the cans may be filled to any desired level, which, when reached, the supply will cease of itself.

TRANSPARENT ICE.

All the freezing processes are by reason of economy in cost and time more or less rapid and this swiftness prevents the air contained in water in solution from escaping. The result is that when water gets congealed, there is an opacity in the block of ice and this opacity, owing to the sediments and air being gradually driven to the centre, increases towards the middle of thickness, and is, besides, less in Indian climate, than in England and other countries of Europe, since the quantity of air held in water lessens in proportion to the rise in temperature. This white core is objectionable, principally, for two reasons : (a) it makes the appearance of ice

less pleasing to the eyes, and (b) opaque ice does not hold out so long as the quality from which air is eliminated.

No great thought was given to the quality of the product in earlier days when ice-making first assumed the proportions of an industry, but with the entrance of many types of machinery in the market and the introduction of an element of competition in the trade, a demand began to arise for a superior article. At first freezing at comparatively high temperatures was resorted to by which at least one part of the block of ice became tolerably clear. But the time required for freezing was so long and consequently required such a large number of cans and an ice tank of such excessive dimensions that the first cost became prohibitive and it had soon to be abandoned. Means were sought to improve the quality of ice without abandoning the economic advantages attendant in the low temperature method. It was discovered that ice blocks could be rendered clear by eliminating the air contained in water and numerous devices have been introduced to attain this end. The more common methods consist of (a) de-aerating the water before filling it in cans or cells, or (b) imparting some sort of mechanical agitation to water during the continuance of the freezing process, whereby air would be driven out.

In the former process, exhaust steam from the engine is condensed and utilised for making ice from. But as this exhaust invariably contains some particles of lubricating oil from the steam cylinder, it is customary to pass it first through simple steam filters. It is then condensed by being passed through cylindrical vessels, around which cold water is applied. The cooling water which becomes hot during the process is profitably used for feeding steam boiler. The water condensed from steam is re-heated by insertion into the vessel holding it of a coil containing live steam and then again filtered and skimmed, when it becomes perfectly deodorised and de-aerated. The water thus distilled is often cooled by the laying in of an evaporating coil through the tank holding it. The ice made from distilled water still,

sometimes, contains a very thin core of opaque ice, frequently red in colour for distilled water oxidises the iron, but it is insignificant and does not injure the look of ice.

There is one difficulty owing to which this method has not been so generally adopted as, by reason of the satisfactory results obtained therein, it should have been done. The exhaust is not sufficient to supply all the water required for ice manufacture and this 'insufficiency' becomes more pronounced as the size of Ice plant increases and steam saving appliances are used in the Engine. The agitation of water in cans by some mechanical means is, therefore, more commonly made use of and among the different methods in vogue, the following are the more interesting and convenient :

(a) Introduction in cans of a perforated pipe extending to within about half the distance from the top. A current of air is forced through this pipe, which, rising in the form of bubbles through the water, produces a circulation in the same whereby air is released.

(b) Insertion into cans of a wooden or metal bar extending to about half the depth of the can. It is kept lifting up and down by means of a mechanical device.

In both the above two, and similar other, arrangements, it becomes necessary to withdraw the inserted tube or bar before the termination of the freezing process to prevent its getting frozen in the blocks of ice. To avoid this difficulty another method of agitation is sometimes employed and it consists in imparting an oscillating motion to can itself while water is in course of freezing, but the gear in the event of a large size tank becomes quite cumbersome and expensive. Hence this process does not find much favor in commercial circles.

When the centre core gets persistent and is difficult to avoid, the trouble is overcome by cutting the ice block in small sizes, 20 lbs. each or so, in such a way that the central white part is thrown away and each block is given the appearance of perfect clearness.

CELL SYSTEM.

In the stationary cell process, an ice tank is fitted with a number of cellular hollow walls of iron. The ends of these walls are cast from pig iron and accurately machined at jointing surfaces. The walls themselves are made from wrought iron plates, usually about $\frac{3}{8}$ " thick. The ends and walls (the latter being commonly known as cell plates) are held tight by means of iron bars running through the entire length and bolted outside the end covers. Both the end castings and side plates are well galvanised to prevent rusting. Rubber sheets are inserted in joints to render them water tight.

The cell ends have holes in top corners for the inlet and outlet of brine. These holes are fitted with pieces of pipes, which are connected by rubber hose on to the distributing heads in the brine mains. The hose is usually 3 ply, armoured with steel, copper or brass, wire.

The water to be frozen is placed between the quadrilateral holes made by the joining of these walls and ends. The refrigerating brine is circulated in the cellular spaces between. The freezing process is carried from both the opposite sides and the frozen surface increases until both layers meet in the centre.

When the water is frozen, cold brine is drawn-off and a charge of warm brine at about 52° Fahr. is circulated through the cells, which serves to thaw the blocks and loosen them on all sides, when they are lifted by the aid of the hooks previously inserted in water and now frozen in. Every tank is provided with separate pipes and valves for maintaining hot and cold brine services and where more than one ice tank is used the connections are usually so arranged that any tank may be joined on or disconnected at will, without interference with the brine service in other tanks.

Unless de-aerated water is used, it is usual to arrange for mechanical agitation of water to be frozen and with this end in view the cell walls and ends are terminated some short distance above the actual bottom of the tank so as to utilise the vacant space as a sort of false bottom. Water is agitated

by means of paddles, worked mechanically in a small chamber in one side of the tank. The paddles in moving give the whole water in tank an impulse to rush in waves between the longitudinal walls and to void air at top. Any impurities present in water settle at the bottom in the space below cell walls where water does not freeze. The agitation gear can be so arranged that its motion may be slackened in proportion as the thickness of ice increases on sides of the walls. When ice blocks have been drawn-off, the dirty water at bottom is drained by means of wash-out cocks fitted to the tanks.

There are two sizes of cell blocks in common use. One of them, which weighs 5 cwt. when frozen solid, is 48" x 40" wide and 9" thick at top tapering to 39" and 8" at bottom. The other, which is only about 2 ft. wide, weighs 3 cwt. The smaller size owing to the economy in handling and breaking is sometimes preferred. In Ice tanks of 3-ton capacity and upwards, an ordinary size of cold brine main service piping is 4" dia. and valves 2½" dia., and hot brine piping and valves are 8" and 2" dia., respectively. The cold brine by-service piping and valves may, in this event, be safely sized at 8" and 2" dia., respectively. Full-away pattern of valves to allow a full flow of brine are considered better. To void the air that often gets into the brine cells and slabs, small air relief cocks should be fitted throughout the system.

Every Ice tank should have its own brine distributing arrangement with cocks for regulating or shutting-off the supply of brine to individual cells. Brass nozzles (1¼" external dia. is ample) should be fitted on these cocks and India-rubber hose (1" dia.), having ends fitted with brass clamps widened and prepared to slip over the nozzles on the cocks and on the cell end pipes, laid on. The cells do not work under heavy pressure but when all bolted together and newly set up, they should, as a precautionary measure, be tested with water pressure to 25 lbs. per square inch and allowed to stand in the test condition for about 48 hours, when, if there are any weak joints, they will reveal themselves.

The shells of ice tanks are made from wooden planks, from 3 to 4 inches in thickness. The covers are, however, of much thinner planks, $\frac{1}{2}$ " to 1" thick, laid double, one above the other, with a 2 or 3 in. hollow space between. When fixed up, the cell tanks are insulated, like the can boxes, with charcoal, etc. The brine service is maintained by means of force pumps, which are often of the centrifugal type. Two of such pumps are provided, one for cold brine and the other for hot brine service. The brine valves and cocks should be so arranged that they may remain within easy access when the tanks have been insulated.

There are two great disadvantages in the cell method of ice making. First, the initial outlay is excessive, extending on the tank portion to nearly three times that of a can Ice box. Secondly, the use a cell Ice tank involves a 12 to 15% higher bill of expenditure in the form of increased time and consumption of fuel, etc. It is thus not quite economical from a commercial standpoint, but in any town where there are several Ice factories, each trying to run at other's throat, cell Ice may fetch a trifle higher price, or, at any rate, be better patronised than can Ice.

FREEZING TIME.

Water freezes more rapidly in cans than in stationary cells. In a plant wherein the displacement area in the compressing pump and other parts are not of insufficient capacity; the time taken in freezing 6" thick blocks of ice, in India, should not exceed 24 hours. But the freezing gets slower as the thickness of blocks increases and the contact of cooled water with surrounding brine recedes. With agitation gear in use, 8" thick blocks may take about 48 hours to freeze solid and 9" blocks about 60 hours. In cell ice tanks the progress of congelation is roughly estimated to be about 15% slower. In case, thicker blocks are used which require 48 or 72 hours to freeze, the ice tank, both in the can and cell system, should have an accommodation twice, or three times, the capacity of the plant. In fact, in the cell Ice tanks, it is usual to provide 300% tank accommodation.

In a 10-ton Ice plant using cell system tanks, three 10-ton, or what would be more convenient six 5-ton, cell Ice tanks are provided so that clear 72 hours freezing time may be allowed to every tank and full 10 tons of Ice may be obtained every day. Freezing process in cells being slow, it is natural that the quality of ice produced is superior and more transparent.

PLATE SYSTEM.

There is yet another method of freezing water. It is known as the plate system and in this process freezing proceeds on one side only over the surface of hollow plates wherein a service of cold brine is kept up. Ice forms very slowly. It is, indeed, impossible to use this method in a factory working on commercial basis unless inexpensive water power is available, such as near water falls. There is, to my knowledge, no plate Ice machine working in this country. Our interest in this process is therefore of purely an academical nature.

ICE ELEVATOR.

After the ice blocks are frozen, they are lifted-up by means of hoists suspended from cranes which are adjusted to travel backwards and forwards, also sideways, over the entire length and breadth of Ice tanks. These cranes carry the blocks to a place where, in the case of can Ice moulds, they are thawed and released by being dumped in warm fresh water and then stored. There is a large variety of travelling cranes put on the market. In the small size plants, the hoisting apparatus is generally worked by manual power, but in large machines mechanical handlings are provided for. The Triumph Ice Machine Company have introduced a pneumatic hoist, worked by a three way valve, which seems to constitute a convenient arrangement for handling ice blocks. Ice hoisting chains, &c. can, however, be locally constructed at very small expense and they work with almost equally satisfactory results.

CHAPTER IV.

DISTINGUISHING FEATURES OF DIFFERENT
MACHINES.

THE WONDERS OF PRACTICE.

I now proceed to mention the distinguishing features and characteristics of some of the leading systems of machinery and to, *inter alia*, explain the divers ways in which the theory and principles of refrigeration, enunciated above, are put into actual practice. The survey will, in a short treatise like this, have necessarily to be confined to a few instances only, and I, therefore, wish to guard against any inference being drawn from this short examination that it in any way reflects, or throws discredit on, the esteemed firms whose systems of machinery are, owing to unacquaintance or want of space, not discussed here. If GOD favors and circumstances at any time permit me to place the fuller results of my investigations in this branch of industry in a proper form before my countrymen, I will then try to do justice to other systems also. Almost every individual patentee and manufacturer has some useful and novel feature of his own and since variations in taste and requirements will always exist, there is very remote likelihood of any particular kind of machine being ever able to have the entire market to itself. Apart, however, from its value as a means for ascertaining the comparative efficiency of the different systems,—a task which is not without its perils and difficulties and which I have found myself incapable of, and have therefore refrained from, attempting to deal with here—the feature which most attracts my attention, and particularly interests me, in this survey is the view its presents of a wonderful exercise of ingenuity and skill on the part of some of the master minds in applied physical science and in mechanics.

I have not confined myself here to a mere general description of the different systems of machinery but have, where possible, supplemented the observations made by

citing the extent and size of plant which those makers respectively consider sufficient for giving a specific result in Indian climate.

I have adopted a plant designed to produce 10 tons of Ice in every 24 hours as the standard for the purposes of basing the specifications, for I consider that this is the size which, if it has not already come in greater demand, promises to soon become a great favourite. 10 tons is about as large a size as the vast majority of our towns can, at the most, keep going and in which, in the opinion of many person connected with this industry, the limit of relative economy is, all points considered, nearly at its highest. If the requirements of any town are larger, it would probably pay, except, perhaps, in huge towns like Calcutta or Bombay, to instal two, or more, 10 ton plants than have a plant of larger capacity in single unit. Because, besides proving costly to run towards the beginning and end of a season, it would also be productive of considerable inconvenience in case of a break-down or accident.

In spite of the fact that there are many considerations in the construction and the character of the compressing pump, etc., which govern the details about the size and effective area of the various parts of a plant, a most remarkable feature of the data mentioned here would appear to be that no two different makers agree in the matter of the details of the machinery specified.

The narration in this chapter is divided into five parts, *vis.*, (a) The Ammonia Compression system; (b) The Ether Compression system; (c) The CO₂ Compression system, (d) The SO₂ Compression system, and, (e) The Ammonia Absorption system.

THE AMMONIA COMPRESSION SYSTEM.

THE LINDE BRITISH REFRIGERATION COMPANY, LIMITED,

LONDON.

The Linde system of ice making is generally considered to occupy a most prominent position owing to the older

establishment of this firm and the large number of their plants in use in all parts of the world.

The Compressors are horizontal, designed for either double action, or, for compound (two stage) working. In double acting machines, half the power may, if so desired, be utilised in conjunction with an ice tank and the other of for refrigeration work of another character at a different temperature. In two stage compressors, ammonia vapours are first drawn into a low pressure cylinder, from which after partial compression, they are delivered into the high pressure cylinder for final compression. A notable feature of the Linde compressor is that it draws from the evaporating coils gas saturated with particles of the liquid Ammonia from which it evaporates. The humid gas absorbs, in expanding, heat from the walls of compressor cylinder and from piston and thus counteracts to a degree the effects of the heat of compression. The stuffing box is packed with compound rings made of duck and rubber. Oil for lubricating the compressor cylinder is admitted from the stuffing box. An oil trap is provided in the discharge conduit between compressor and condenser and a check valve, the duty of which is to prevent loss of gas in case of accident to the compressor, is fitted between compressor and oil trap.

The condenser is of the atmospheric type. The coils are of lap welded steel, wound each in one length and joined with the other coils by means of steel flanges. The drips trips are perforated so as not to interfere with a free circulation of air. The condenser consists of several sections, every one of which is complete in itself and as an in-let and an out-let valve of its own. The condensers are usually tested to a pressure of 500 lbs. per square inch.

In case of can Ice tanks, the expansion coils are uniformly distributed throughout the tank, which is, besides, fitted with a propeller for circulating the cold brine over the coils and around the ice cans. When transparent ice is required an ordinary water distilling plant is supplied, or a kind of hydraulic agitation gear is provided for agitating water in

cans. With this latter gear in efficient and continuous operation, Ice is rendered clear to within about 7 per cent. of the total volume of the block.

For a plant designed to produce 10 tons ice daily, in India, this firm specifies a horizontal, double-acting, Linde compressor, 10" x 21". 2,000 lineal feet of 1½" out-side diameter (inside dia. 1⅜") iron tubing in the condenser, fitted with a 2½" inlet valve and ¾" outlet valve. 200 Ice cans, 36" deep x 30" wide and 7½" thick at top tapering to 28" x 6½" near bottom. The refrigerator coils have a total length of 2,400 ft. They are not usually galvanised.

ARTHUR G. ENOCK & CO., LTD., LONDON.

The compressor is of double-cylinder, single acting, vertical type and has large diameter suction and delivery valves, the former being of nearly the same diameter as the compressor piston. The valves are accessible and removable by merely taking-off the top nuts. In case of machine being negligently started with the delivery valve shut, a safety arrangement is provided whereby the pressure in the compressor will rise to about 240 lbs. the discharge pipe and cannot then rise any further, the weight of the gas on the piston being sufficient to cause the cross-head spring to close home and the column of gas then merely compresses and re-expands in the cylinder without getting discharged. The back of stuffing box in the compressor is covered with an oil bath to prevent escape of gas, of which otherwise also there is little risk, as, in a single acting machine, the pressure of gas on the suction side should rarely exceed 30 lbs. per square inch. Plugs are provided, instead of guage glasses, for ascertaining height of oil in bath without opening up the chamber.

For a plant designed to produce 10 tons ice every day, in India, this firm specifies two Enock, single acting, 9" dia. x 15" stroke, compressing pumps.

The condenser is of the double-pipe type. The can ice tank is 35' long x 14' wide x 5'-3" deep, with 1½" bore evaporating coils spread evenly throughout. 110 Ice cans,

22" x 60" x 11" thick across top tapering to about 10" at the bottom, capacity 400 lbs., made from No. 14 B. W. G. galvanized sheeting. The cans are calculated to freeze solid in 48 hours.

Water distilling apparatus is recommended for producing perfectly clear ice, but, if this may not be preferred, an agitating apparatus is provided which disperses the bubbles which form on the ice as the blocks freeze up and consists of a pump drawing its supply from a small tank and discharging a jet of ice cold water periodically through a nozzle placed over each ice can. The surplus water may either be drawn-off by the pump or pass back through an overflow to the small tank. Each row of nozzles is shut off by action of a head valve, shortly before cans are to be drawn, to allow the centre of block to freeze-up.

THE TRIUMPH ICE MACHINE COMPANY, CINCINNATI, U.S.A.

The compressor is of horizontal, double acting, type fitted with five valves, two ordinary suction and two discharge and one auxiliary (safety) suction, the latter has comparatively lighter springs than the others. The compressor cylinder and dome are water-jacketed. The valves are seated outside the main body of the cylinder. All valves and cages are of steel, fitted with regulating devices which are explained in full detail in Chapter II. The stuffing box is divided into 3 compartments with two intermediate oil chambers. A complete system of By-Passes, as also an oil trap, are provided.

The condenser is usually of the atmospheric type, arranged in sections, each of which is 16 pipes high x 20' long, two inch wrought iron coils, weighing 5 lbs. per lineal foot, fitted with its own gas, liquid and pump-out valves. The liquid receiver, which is somewhat similar in construction to the oil trap, may be fitted with a gas relief connection to the condenser.

The expansion coils consist of 1½" dia., wrought iron pipes, placed throughout the Ice tank. The coils are, in case of larger plants, divided into sections, each of which is com-

plete in itself and has separate regulating and shut-off valves and steel return bends. The heads in ammonia pipes are screwed and soldered. The brine is agitated in Ice tank by means of a force propeller. Pneumatic hoists, having brass tube barrel are supplied for lifting moulds of ice.

For a plant designed to produce 10 tons of Ice daily in India, this firm specifies one 10" bore x 20" stroke girder type Triumph compressor; piston rod 15/16" diameter. Oil interceptor 5' high x 12" dia. Three sections of atmospheric type condenser. Gas header for condensers is of 3" dia. pipe joined by a reduction socket to the 2" condenser pipes. Liquid Ammonia receiver, 60" high x 12" dia. Brine tank, 35' x 22' x 3' made of 1/2" steel plates; top stiffened all round with 3" angle iron. 3,240 feet of evaporation coils. built in 18 sections, of 1 1/4" W. I. pipe, (8 lbs. per foot) connected together with 1 1/4"-U-4" steel return bends and 1 1/4" drop steel flanges. Expansion header of 2" dia. pipe fitted with 1/2" nipples; suction header of 3" pipe into which 1 1/4" nipples are screwed. One 18" dia. bronze propeller with 1 15/16" shaft for agitating the brine. Sufficient number of Ice cans, 8" x 16" x 31 1/2", 300 lbs. capacity, made of No. 16 B. W. G. galvanised iron sheets, reinforced at the bottom and having 1/2" x 1 1/2" iron bands around the top.

Distillation of water from exhaust steam: One 4" x 19 1/2" high vertical or horizontal steam separator. One surface steam condenser, 16' long x 4' high x 18" at the bottom, made of No. 10 gauge iron. One combined re-boiler and skimmer, 36" dia. x 48" high, made of No. 14 iron sheets, fitted with a live steam coil. One flat cooler containing 200 ft. of 1 1/4" iron pipe, in 2 coils, and fitted with distributing heads. Two charcoal filters, 36" dia. x 72" high, made of No. 12 iron sheets, with water flow reversing arrangement. One cooling water storage tank, 48" dia. x 72" high, made of 12 gauge sheets and fitted with 150' of 2" ammonia expansion piping. One Porcupine filter, 5" dia. x 20" high. One 4 1/2" x 3 1/4" x 4" duplex pump for cold brine service.

THE YORK MANUFACTURING COMPANY, YORK, U.S.A.

This firm possesses extensive works in York, where it claims to employ the energies of over 1,200 men to the manufacture of Ice making and refrigerating machinery alone. York machines are noted for their adaptability to all climates and their vast range of types, varying in single units from a plant of 500-ton refrigerating capacity, worked by 625 H. P. compound, corliss valve, horizontal, steam engine, to small plants designed for use in private residences.

York compressors are usually of vertical, single-acting, pattern, fitted with false or safety head. The gas enters at the bottom and passes up through the suction valve in the piston, which in its upward stroke compresses and delivers the same through a discharge valve in the centre of the safety head, by way of the oil trap, into the condenser. The piston and safety-head faces are faced off square with a view to allow a complete discharge of gas. The compressor is encased in a water jacket. The water enters at the bottom and, circulating around the walls of the compressor, flows out over the top cover.

For a plant designed to produce 10 tons ice daily in India, this firm specifies two of its single-acting, vertical, ammonia compression pumps, 11" bore x 20" stroke. A Hand pump for lubricating gas cylinder and stuffing boxes. Pistons are fitted with metallic packing and piston rods with soft packing. By-pass arrangements as in other machines. Ammonia condenser:—(a)—atmospheric type, 4 coils (each coil 24 pipes high x 20' long) of 2" dia. tubing, or, (b) double pipe type, 4 coils (each coil 12 pipe high x 19' long) of 1½" inner, and 2" outer, tubing.

Ice tanks for can system: Three in number, made of ¼" steel plates, each 26' long x 13½' wide x 4' high, containing 100 cans. Each can, 8" x 22" x 45", 14 guage thick and 60 lbs. in weight, 200 lbs. capacity. About 1,100 ft. of 1½" expansion coils fitted in each ice tank. Every tank furnished with rotary agitator for circulating brine. An independent 5" x 6" horizontal, centre crank, engine for working agitators. The

cans are fitted with tubing to which is attached air hose. Air is compressed and conveyed through this hose to the bottom of the can, and, in forcing its way up, it agitates and de-aerates the water in the cans.

THE HERCULES ICE MACHINE.

The Hercules machine is of the vertical compression type, having two single acting cylinders with suction and discharge valves in top head. The gas enters an annular chamber at the bottom of the cylinder and is carried through a passage way cast in it to the suction valve. From the annular chamber into the cylinder are a number of ports. When the piston is on the down stroke, the gas passes through the suction valve into the cylinder, but when it reaches the bottom the incoming gas has free access through the ports. The compressor cylinder is water jacketed. The water entering up the bottom, surrounds the cylinder and covers the top head, passing off through a chamber cast in jacket.

For a plant designed to produce 10 tons ice every day in India, C. A. MacDonald, the patentee of the Hercules Ice Machine, specifies two single acting Hercules vertical compression pumps, 9" dia. \times 18" stroke, which, it is claimed, require only about 40 H. P. to drive them. In-let valve, $8\frac{3}{4}$ " dia.; out-let valve, 2" dia. Piston, $8\frac{1}{2}$ " thick solid; cylinder sides, $1\frac{1}{8}$ " thick; top head containing in-let and out-let valves, $4\frac{1}{4}$ " deep. Valve and valve cages are made from forged steel.

The Ammonia condenser which is of the atmospheric type, consists of two parts, (a) the preliminary condenser lying horizontally on the floor of tank immediately underneath the liquefier, and, (b), the liquefier or receiver proper, made of $1\frac{1}{4}$ " iron pipe weighing 8 lbs. to the foot. The ammonia gas enters at top and the liquid is drained off at bottom. Sprinkling troughs, placed over the coils, distribute the condensing water. A total length of 4,266 feet of 1" oval shaped expansion coils (weighing $2\frac{1}{2}$ lbs. per foot) are fitted in the Ice tank, which is made of $\frac{1}{4}$ " steel plates. Inner

dimensions of the Ice tank are 27' long \times 18' - 3" wide \times 6' deep and it contains 168 cans, each 60" deep \times 22" long and 11" wide at top tapering to 21 $\frac{1}{2}$ " \times 10 $\frac{1}{2}$ " at bottom ; sides 15, and bottom 14, guage thick ; tops strengthened with $\frac{1}{4}$ " \times $\frac{3}{8}$ " iron bands. Refrigerator coils are placed in rows with ice cans arranged between them, the distance from edge of coils to edge of cans being 1 $\frac{1}{2}$ ". Brine discharge pipes, lying under cans, in 16 rows running full length of the Ice tank deliver jets of cold brine upwards along the sides of cans. Brine suction pumps are placed near the top level.

An automatic can filler is provided to fill the cans to any desired height. For making transparent and sterilised ice, water is distilled before being filled in cans. For this purpose, exhaust steam is taken from Engine and filtered and condensed. Reboiled and skimmed to drive off air and traces of grease or oil, filtered in three stages and through three different media (sand, charcoal and sponge) cooled with water and finally, chilled by insertion of an ammonia expansion coil in the storage tank before delivery into Ice cans. No agitation of freezing water in cans being required, when ice is made from de-aerated water, the cans are not, when once put in, disturbed until ready for being drawn out. It is not customary with this system to freeze up all cans solid and then draw same. When once frozen solid, it works on continuously and cans are drawn in rotation, one after every 25 minutes or so. By this means, it is thought, the load on machine is kept constant and conditions for maximum economy obtain. Every can has, therefore, a separate top frame and wooden cover, forming a sort of separate compartment for itself.

L. STERNE & Co., LIMITED, GLASGOW.

In the compressor made by this firm and popularly known as the De La Vergne machine, the cylinder casting is, in the case of horizontal pumps, fitted with two piston rods, both of which work outside the cylinder proper. One advantage of this is that these rods are not subjected to the same variations of temperature as those which pass through the compression,

chamber in other double acting machines. The piston is double ended and has a suction valve on each end. There are, as it were, two cylinders arranged horizontally, tandem wise having their inner or adjacent ends opening into a chamber of larger diameter than the cylinders, into which the incoming or return cold gases enter. The suction valve plate is formed of thin steel. The safety cylinder heads at both ends carry the discharge valves and are movable, held pressed to their seats by means of spiral springs. They are of the same diameter as the piston. The piston rods are connected to arms extending radially from the centre of the points. As the rods pass through glands in the suction chamber, the latter has to be packed against suction pressure and low temperature only. The compressor cylinder has no water jacket.

The characteristic feature of the De La Vergne vertical compressor consists in flooding the interior of the cylinder and piston with oil, while in operation, to fill up clearance spaces and help in the absorption and carrying of the heat incidental to compression at high points. The clearance space between the piston and the ends of the cylinder, the suction valve, the piston-valve, the discharge valve and the stuffing box all, in their turn, get sealed by oil, but since oil is capable of absorbing ammonia gas under a high pressure, which would get released and expand during return stroke of the piston, there is an imminent risk of the suction pressure getting reduced and efficiency of the machine lowered. The suction valves are located in the suction passage near the ends of the cylinder, but the upper discharge valves are fixed in the loose safety head.

The De La Vergne vertical compressors are designed for double action, but since in the down stroke of the piston oil is apt to get discharged before gas has time to let itself off, the difficulty is sought to be overcome by having two discharge valves at the lower end of the cylinder, one above the other. On the down stroke either of the valves, or both, may open until the piston covers the upper one, when only

the lower one is open to the condenser. In the further course of the piston, and as soon as the lower valve is also closed, the upper one is in communication with an annular chamber contained in the piston. This chamber has valves in its bottom, which open into it as soon as all other outlets from the lower side of the piston are closed (being a little harder to open than the discharge valves on the side) and the gas then goes out through the piston. After the gas the oil follows. A continuous connection is thus maintained between the entire cylinder and the discharge chamber, notwithstanding that the piston obstructs at times both valve openings in the passage.

Before being taken to the main condenser, the mixture of compressed gas and oil is taken to a fore-cooler, where some little part of the heat is removed to enable the oil to be drained and collected in a tank provided for the purpose.

In the condenser, which is of the atmospheric type, the gas inlet valve is located at the bottom, the ammonia gas being cooled as it rises in the coils. The liquid, as it forms, is drawn off by small pipes attached to the coils at different levels. These pipes run into a header which is connected to a storage tank. The pipes used are, generally, of 2" diameter. The condenser is often divided into several sections, each complete in itself, and having independent connection with the mains. Metal strips are fitted under each pipe to prevent spattering and get over the difficulty of water not covering the whole surface of the pipes next below. All joints are made on the 'screwed and soldered' method. The thread into which a pipe screws does not reach entirely to the outside but the fittings are enlarged to a depth of $\frac{1}{2}$ to $\frac{3}{4}$ inch, forming a smooth annular space beyond termination of the thread.

For a plant designed to make 10 tons ice daily in India, this firm specifies a 11 $\frac{1}{2}$ " x 22" De La Vergne double acting horizontal dry compression machine. Five open air condensers having in all 1,800 ft. of 2" dia., No. 8 gauge, tubing.

Cell Ice Tanks : six in number, constructed of 4" thick

Baltic fir planks. All iron work and bolts galvanised. Every tank fitted with underneath agitation and to have seven rows of 8 cells, 44" x 48" x 9", capacity 5 cwts. *viz.*, 21 in all. Slabs made from 3/16" thick wrought iron sheets, each side being made in one whole-piece, well stayed, finished plain on both sides and flush rivetted. Cell ends of hard, close grained, cast iron, accurately machined on jointing surfaces. Cell slabs and cell ends held together by strong bolts tightly fastened and tank, when fixed up, tested by Hydraulic pressure to 17 lbs. per square inch. Hot and cold brine connections and discharge tanks; centrifugal type brine pumps. 2" drain cock fitted to each tank. Ammonia refrigerator in a separate tank (24' x 5' x 2') having about 2,000 ft. of 2" bore coils, No. 8 guage, complete with cocks and connections, or,

Can Ice Tank :—one in number, of wrought iron plates, having about 2,000 ft., 2" bore, No. 8 guage, ammonia expansion coils spread throughout. 154 ice moulds, 30" x 30" x 7½", of No. 12 guage galvanised, steel sheets, weighing 2 cwts. each. Rotary brine agitator. The cans in which the ice is made are deeper than the required block of ice and are submerged in cold brine to the depth of the required block. The water in the cans is mechanically agitated by paddles which revolve in the portion of water that is above the brine line. The result is a tolerably clear ice without distillation. The water above the brine level remains unfrozen. This process for making clear ice may, perhaps, be found to work rather more expensively than some of the methods described in connection with other machines, since the temperature of a much large quantity of water would have to be lowered and the cold water remaining unfrozen at top, even if pumped into a storage tank in a non-contaminated state, may not give satisfactory results in re-use.

G. J. WORSAM & SON, LONDON.

The compressor is of double-acting, horizontal type. A special metal liner is forced inside the cylinder body, forming an annular space round the working barrel. This annular

space is connected with the low pressure suction side, whence cold gas escapes and circulates round the jacket keeping the compressor cool. The suction and delivery valves are of hammered scrap iron, constructed entirely in one piece and work in cages. The small lift of the valves is taken up by means of spring buffers. The valves can be removed from the compressor without disturbing any of the pipe system. Piston rod works through metallic packing rings fitted in the gland.

For a plant designed to produce 10 tons Ice in India, every day, this firm specifies.

Ammonia compressor : Horizontal, 9" diam. \times 22" stroke, gas-jacketed cylinder. Thickness of cylinder and jacket, $\frac{3}{8}$ ". Valves, conical lift type, $1\frac{7}{8}$ " dia., with special cages and springs. Piston, 9" thick. Piston rod, $1\frac{1}{2}$ " dia.

Ammonia condenser : Lap-welded steel tube, 1580' \times 1.88" external dia. \times 6 gauge. Coils immersed in a water tank. Inlet valve, 3" ; out-let valve, 1". Condenser tank, steel, 6' dia. \times 9' deep of $\frac{1}{2}$ " & $\frac{5}{16}$ " steel plate.

Refrigerator. As condenser.

Ice Tanks : Six in number on the cell system, each producing 24 blocks of ice 50' \times 42" and 9" at top tapering to 39" and 8 $\frac{1}{2}$ " at bottom. Shells of 3 $\frac{1}{2}$ " thick Baltic fir ; joints made with rushes. End cell castings cored to give an efficient brine circulation when coupled up to the side cell plates, which would be of $\frac{3}{16}$ " steel riveted up with distance pieces to give an internal brine space. Sides and ends held together by through bolts and the whole surface of iron exposed to ice to be smooth and clean. Agitation gear : floats actuated by levers and connecting rods. Distribution boxes with pipes and fittings to distribute brine from main supply ; return boxes to take brine from cells into return mains. Separate shut-down and cross-over valves for every tank. Centrifugal pumps : cold brine, 5" dia., hot brine, 8" dia. Wash out cocks, 3" dia. Over all dimensions, 12'—6" \times 9'—8" \times 5'—7". NH₃ coils and pipes tested to 2,000 lbs. hydraulic pressure,

or, 8 Can Ice Tanks (18' long \times 12' - 6" wide); each tank having 52 moulds, 48" deep \times 44" and 8" at top : 41" \times 7" at bottom, of 12 guage sheeting. Each mould to have a $\frac{3}{8}$ " \times 2" flat band round top and another about half the depth on the outside. Tanks of 8th Baltic fir, rush jointed, 2" wash out branch and cock. Agitation by floating blade gear. The blade is hinged on a shaft, falls by its own weight in the can and is lifted by means of the gear causing disturbance in the water and de-aerating the same.

The whole NHs plant, when erected, tested to 800 lbs. per square inch and left off tight for 24 hours.

THE HASLAM FOUNDRY AND ENGINEERING COY., LTD.,
LONDON.

The Haslam horizontal compressors are made in two patterns, one being of the usual double-acting type with suction and delivery valves in end covers and the other of two-stage type. The object in view in the two-stage machine is to prevent the gas from escaping or coming in contact with air and to avoid dead spaces. A small quantity of oil is passed along with the gas in the low pressure cylinder, by a cock or valve, through the suction valve and the compression to the desired extent is then carried out. The cylinders are water jacketed.

Ammonia condensers are of the open-air type. The compressed gas is admitted at the bottom, and as it rises and gets liquefied, it leaves the condenser by means of small pipes fitted at ends at different levels. Condensers are constructed in sections, each provided with independent valves and cocks. The coils are of wrought iron, lap-welded, black pipe having 'screwed and soldered' joints connecting the same with return-bends. Water distributing pipes are fitted on top and fin plates are provided for causing equal distribution of water.

When an Ice plant is fitted with cell Ice tanks, an independent brine cooler is supplied fitted with the ammonia cooling coils, and the brine is circulated from this cooler into the brine cells. In case of a can Ice tank, the ammonia

cooling coils may be placed in the Ice tank itself. Whichever the system adopted, the brine is cooled down from 5° to 15°, F., according to the quality of ice required and the quantity to be turned-out in a given time. A fore-cooler and storage tank may be provided, fitted with NH₃ coil, for cooling the water before it is passed into the cells or cans.

In can Ice Tanks, agitation is maintained by means of wooden blades mounted in frames above the Ice moulds. When the freezing process is nearing completion, agitators are removed and the moulds frozen up solid. Brine in the Ice tank is agitated by a propeller. The standard sizes of Ice cans, which are the same as commonly used in India and excellently adapted for the requirements of this country, are : 1 Cwt., measuring 24" x 24" x 6"; 1½ Cwt., 30" x 30" x 6" ; 2 Cwt., 30" x 30" x 8".

The cell Ice Tanks are fitted with agitators working in a partition at one side and through perforated iron false bottom. A common size of their cell ice block is 48" x 32" x 9" weighing 4 Cwt.

A 10-ton Haslam Ice-making plant, working at Messrs. S. B. Fraser & Son's Factory in Bombay, has one compound, single-acting, high pressure compressor, 9" dia., and one double-acting, low pressure, compressor, 11" dia., both 24" stroke. It requires about 66 H. P. to work it. As an alternative, this firm specifies a 13" dia. x 24" stroke, horizontal, double-acting, machine to make 10 tons of ice in India per 24 hours, even where initial temperature of condensing water rises as high as 100° Fahr. 2,500' run of 1½" bore (1¾" outside dia.) pipe is supplied in the Ammonia condenser and the same amount in the brine cooler.

FRICK COMPANY, WAYNESBORO, U. S. A.

In the Ice machines made by the Frick Company, and generally known as Eclipse machines, every unit consists of a pair of single-acting vertical compressors, driven by a horizontal steam engine, all forming one structure. The suction valve, which is of steel balanced by a spring, is situated in

the piston, which is itself fitted with 5 spring rings. The gas inlet is in the base of the pump. As the up stroke begins, a cushion and spring assist in closing the suction valve. The imprisoned gas is then gradually compressed until it equals the condensing pressure acting upon the discharge valves, located in the pump dome, when discharge begins. The dome and cylinder of the compressor pump are enveloped in a water jacket. The pump is fitted with a movable (safety) head, in the centre of which a steel discharge valve is fixed. The safety head with its discharge valve, guides and seat, are self-contained and independent of the pump. A small valve is provided at a corner in the top head for taking indicator diagrams from the pump and to inject oil. Usual by-pass arrangements are provided.

The condenser—which can be made of any type, submerged, atmospheric or double-pipe—is divided into independent sections. The double-pipe condenser is recommended where water has to be used over again for some other purpose.

The ammonia evaporating pipes are placed, in the can system, in Ice tank itself in parallel rows with space between each set to admit of a row of Ice moulds being submerged in the cold brine. Ice moulds are made usually in the following sizes :—

8" × 8" × 32" (16 guage) = 50 lbs.

8" × 16" × 32" (16 guage) = 100 lbs.

11½" × 22½" × 32" (16 guage) = 200 lbs.

11½" × 22½" × 45" (16 guage) = 300 lbs.

11½" × 22½" × 58" (14 guage) = 400 lbs.

All cans have wrought iron bands, are well braced, riveted and soldered smooth inside, galvanised throughout, and have standard taper.

THE ETHER COMPRESSION SYSTEM.

The Ether process has, owing to its comparative low efficiency, fallen into disrepute in Europe, and with its disusage in their home continent, the European firms of refrige-

rating engineers have almost given up the manufacture of this class of machines. But low pressure Ether machines have, for long, enjoyed great popularity in India. In fact, for a number of years the Ether system was in popular belief the only process confidently expected to stand the trying conditions of the more hot parts of India. But such notions do not any longer fetter the path of progress. Ammonia and CO₂ have both been tried and proved satisfactory and these are now fast displacing the expensive Ether system.

The simplicity and immunity from risks of leakage coupled with facilities in the control and working of the Ether machines is, however, a valuable factor in their favor and they will for long remain in the market as the only convenient plants for smaller stations, where competition is not keen.

For a long number of years the Ether Ice machines built by the firm of Siddeley and Mackay continued to command great reputation for reliability and efficiency, but since the failure of this concern, H. J. West & Co., now of Saxilby, have stepped into the market and got the entire field to themselves and, be it said to their credit, have handled this trade with considerable skill and displayed a remarkable, mastery of detail and adaptability to Indian conditions. H. J. West & Co. make Ice machines on the Ammonia and CO₂ systems, also, but it is for their Ether machines that they command more reputation in India and I will, therefore, give a brief description of their Ether machines here.

Ether Ice machines have also been made by Samuel Puplett. Some of them are said to be working satisfactorily in Egypt and the Far East, but to my knowledge they have not so far been introduced in India.

H. J. WEST & Co., LIMITED, SAXILBY.

The compressor cylinder is of cast iron, horizontal, double-acting type. Every compressor is fitted with 8 valves, 2 suction and 2 delivery in each end cover, whereby it is claimed that a large area is combined with a small lift. The

Valves work noiselessly and are so arranged that they can be withdrawn without disturbing existing connections. The valves have thin steel cover plates held tight by spring seats. The suction and delivery ports of the front and back covers are connected by cast iron pipes having machined flanges to which screw down valves are attached to cut off connection with condenser and refrigerator when opening up for examination. The piston has metallic ring packing. The displacement of these compressors ranges approximately from 155 cubic feet per ton in 5 and 6 ton Ice machines to 145 cft. in a 10 ton machine. The size of compressors are fixed somewhat as under ; for 6 ton machine, 25" dia. x 28" stroke ; for 8 ton machine, 27" dia. x 30" stroke ; for 10 ton machine, 30" dia. x 36" stroke.

The condenser is of the submerged type and is made from seamless drawn brass tubes, secured to gun metal tube plates and fitted with gun metal covers. The tube end covers and plates are coated with tin. The condenser is fitted with an air escape valve and could be divided into two portions to ensure greater efficiency.

The Refrigerator is of similar solid-drawn brass tubes surrounded by a copper jacket. The end plates containing tube ends are coated with tin at all jointing places. The Refrigerator is fitted with a suction dome and it may be placed, in can system, in the Ice tank itself, or, be of the external type insulated with felt and lagged with wood. The return liquid pipe from condenser to refrigerator is usually of copper and all flanged joints are made of surfaced sheet lead.

A cooling surface of about 1,170 square feet in the condenser (3,000 ft. of 1½" dia. pipe) would be ample in a 10-ton Ice machine. Refrigerator to also have an equal cooling surface.

THE CO₂ COMPRESSION SYSTEM.

By one of those strange ironies of circumstances, which often remain a mystery to the uninitiated lay public, the

foremost firm of refrigerating engineers in Great Britain has discarded the ammonia system, which, otherwise, has got about 90% of the field in this industry to itself, in favor of the dry air carbonic. In their Dartford Ironworks, J. & E. Hall devote the entire energies and attention of about 1,000 workmen to the production of CO₂ machines.

In J. & E. Hall's system, the compressors for larger machines are bored out of solid steel forgings to secure the strength necessary for the very high amount of pressure under which CO₂ machines have to work. The compressors for smaller machines are cast in bronze. The suction and delivery valves are identical for facilities of interchange. The gland is made gas tight by means of two cupped leathers on the compressor rod. Oil or glycerine is forced at a high pressure into the space between these leathers, so that whatever leakage takes place at the gland is a leakage not of the gas but of the oil or glycerine. When this leakage is into the compressor, it serves the double purpose of lubrication and filling-up of clearance spaces. The oil discharged with gas through delivery valve is trapped in an oil separator and made to impinge against the sides of this vessel, whence it is periodically drawn off. Stop valves are provided both on suction and delivery sides of the compressor to shut off the CO₂ when compressor has to be opened up. An ordinary spring safety valve, having a thin copper disc at its base, is also provided in the compressor to relieve any excessive pressure considerably below that to which the machines are tested.

The condenser consists of coils of wrought iron hydraulic pipe and is constructed, according to circumstances or requirements, on the submerged or atmospheric type. The evaporator, likewise, consists of nests of iron pipes welded up into long lengths. A regulating valve is placed between the condenser and evaporator for adjusting the quantity of liquid CO₂. Jointing rings turned out of a copper alloy are used when joints are subject to a high temperature to have the necessary elasticity and to ensure joints remaining

tight when either hot or cold. The tightness of all joints may be tested by brushing them over with soap and water, same as prepared for shaving, when the slightest leak would be detected.

For Ice making, the evaporator coil is placed inside a steel ice tank, which is fitted with suitable galvanised ice moulds. This tank is provided with rocking gear by means of which the moulds are caused to oscillate while freezing and thus set at liberty the air bubbles which otherwise render ice opaque.

The machines are made in some 40 different sizes and designs to suit various requirements, and are of both vertical and horizontal type and having single-acting or double-acting pumps.

For a plant designed to make 10 tons ice in India, every day, J. & E. Hall specify one of their No. 13a horizontal, double-acting, compressor^o 4½" dia. x 21" stroke, cut from a solid ingot of high carbon steel, or, as an alternative, No. 12b two stage type machine having vertical single-acting compressors. The condenser to consist of a series of coils of 1" wrought iron pipe, hydraulically welded, having a total length of 3,910 feet, contained in a circular casing. The evaporator is of similar construction and dimensions.

THE SO₂ COMPRESSION SYSTEM.

As a type of the construction of SO₂ Ice making plants, I give a description of SO₂ machines made by William Douglas & Sons, Limited, of Putney, London. The Compressor in the Douglas-Conroy patent consists, in case of small vertical machines, of a single-acting, water jacketed, cylinder. The piston is driven by a disc, which is attached to a spindle that passes through the body of the condenser. The condenser is made of cast iron and the compressor is bolted to the side. The water jacket permits of a partial condensation, in the cylinder itself, of the SO₂ which, when in liquid condition, possesses excellent lubricating qualities, so that no oil is required to be fed in the cylinder. This is a

great convenience and the difficulty of oil coated condenser and refrigerator coils is absent in SO_2 machines. The valves are placed on the top of the cylinder. The larger compressors are built on the horizontal, double-acting, principle, with separate condensers and evaporators. The cylinder and gland are water jacketed.

The condenser consists of a cast-iron tank and forms, in vertical types, the foundation of the compressor, which is fastened to the side of it. A coil of wrought iron pipe (tested to 500 lbs. pressure), welded into one piece, is placed in the above tank, and inside of this SO_2 gas is liquefied by pressure from the compressor aided by a supply of cold water. The evaporator is usually a galvanised iron tank, filled with brine, in which is submerged a spiral welded coil, wherein the liquid SO_2 evaporates owing to abstraction of heat from brine aided by suction from the compressor. The cold brine is pumped into the Ice making tank, which is usually placed above the level of the evaporator, so that brine may return thereto by mere force of gravitation. In direct expansion installations, evaporator coils are placed in the Ice tank itself. This firm often insulates its evaporators on the outside with cow's hair, a practice to which, in India, the Hindus may well take exception.

SO_2 Ice machines are also manufactured by A. Borsig, Tagel, Berlin, in Germany.

THE AMMONIA ABSORPTION SYSTEM.

Among the few types of Absorption machines now on the market, one is that made by Ransomes and Rapier, Limited, of London. Their method of construction and working is briefly as follows :—

The refrigerating machine consists mainly of five parts known, severally, as Ammonia generator and separator, rectifier, condenser, absorber and a combined heat exchanger and weak liquor cooler. All of these are constructed on somewhat the same way. There is a wrought iron cylindrical vessel having, at both ends, cast iron covers bolted on

to it. Wrought iron tubes, screwed at one end in this cover, extend horizontally through the cylinder. The tubes are closed at the further end, near which they are supported by a tube plate. A cast iron header, having a cover, is bolted on to the end plate. Smaller pipes fixed in the header run through the centre of the tubes. All the tubes are screwed into the cover and afterwards expanded to ensure tightness of joints.

In the generator the tubes are only in the lower half of the cylinder. In the exchanger there are two sets of tubes, one set being used for further cooling the weak liquor before it enters the absorber. Steam is used in the generator tubes, but in the other four vessels condensing water circulates in the outer tubes. In all cases, the ammonia pressure is in the cylinder and outside the tubes.

The ammonia pump is generally of the direct acting steam driven type, fitted with a long stuffing box, so arranged that any leakage passing the first packing is carried back into the suction. The valves are of vulcanite. The gauge fittings for showing the level of the ammonia in the different vessels are made to close automatically in the event of a glass breaking.

In a 10 ton Ice making plant, ammonia liquor circulating pumps are often fitted in duplicate and are mounted on the generator; and the rectifier, exchanger, absorber and condenser are mounted one above the other, the condenser being at bottom and the rectifier at top. If a break should occur at any time, the header can be taken off for examination whilst the pressure of ammonia is in the machine and, in case the leakage cannot be stopped, a plug may be put in the end of the tube and the machine worked without it with a slight reduction in out-put.

A steam trap is provided for draining the condensed steam from the generator. A rotating valve, actuated by a float (all enclosed in an iron casing), regulates the flow of the weak liquor.

The can Ice tank, 40' x 18' x 4'—6" is made of 30" square

cast iron flange plates and is supplied with wrought iron bearers for carrying the covers. 200 Ice cans, $24'' \times 8\frac{1}{2}''$ at top tapering to $21'' \times 7\frac{1}{2}''$ at bottom $\times 48''$ deep, capacity 2 cwts., made of No. 11 gauge steel sheets, riveted to strong top and bottom frames and outside protecting bands, galvanised after manufacture.

About 3200 feet run of $1\frac{1}{4}''$ nominal bore wrought iron freezing coils, in continuous lengths, tested to 1000 lbs. pressure. One 6" centrifugal pump for circulating the brine. An ordinary apparatus for producing distilled water from condensed steam is also supplied.

PROVISO.

The specifications of size and dimensions given above are for working under normal conditions of atmosphere and climate, where the initial temperature of water used for condensation of compressed refrigerating gas does not, ordinarily, exceed 90° Farh. For more trying conditions, it is possible that the machinery enumerated may not give a full out-put of 10 tons daily. Minor alterations may also be rendered necessary to suit the requirements of a particular locality.

CHAPTER V.

MISCELLANEOUS OBSERVATIONS.

CHARGING AN ICE PLANT.

When about to newly start a machine and put in the first charge of the refrigerating agent, it is desirable to see that the machine is perfectly air tight. This can be done by jointing together the entire system, through which the agent in any shape has to pass, and testing the whole with air pressure which may vary as under :—

In case of Ammonia plants, 800 lbs. per square inch.

In case of SO_2 plants, 125 lbs. per square inch.

In case of Ether plants, 80 lbs. per square inch.

In case of CO_2 plants, 1,400 lbs. per square inch.

The machine should be left charged with the full amount of pressure necessary for about 48 hours and if it does not show any reduction of pressure at the end of that period the air discharge valve, usually proded in the condenser, should be opened and the air well pumped-out. When a good vacuum is obtained the flask containing the liquid agent may be connected, by means of a pipe, with the charging valve and the expansion valve closed. If the machine is then run at a slow speed with the compressor suction and discharge valves open the flask will soon be emptied. The air relief valve in the condenser may then be cautiously opened and the remaining air which has accumulated near that end be slowly and carefully driven-out. As soon, however, as the agent itself begins to escape (which can be detected by the mere smell in Ether, NH_3 and SO_2 machines), the air valve should be closed. More flasks full of the liquid agent may then be connected with the charging valve until a sufficient supply is charged in. The charging valve should then be finally closed and the main expansion valve opened and regulated and the machine brought, by slow degrees, to its full working speed.

INSULATION.

The tanks in which ice is frozen should always be well insulated. Good insulation is bound to pay its own way in the long run, but the manner of its use greatly determines the efficiency of materials used. Comparatively poor materials may prove more satisfactory, when judiciously laid, than materials of a high quality in an ill-arranged order. Apart from its value as a non-conductor of heat, the insulating material should be free from offensive odour and as far as possible incapable of imbibing moisture from atmosphere, nor should it melt away in water. It is highly desirable that the material should be fire and vermin proof, and, above all, it should not be expensive.

Cork, owing to its non-hygroscopic properties, is a great favorite in many countries where it grows in abundance. But

we cannot very well use it in India. Some of the substances which could conveniently be used in India are mentioned below and the conducting power for each square foot of surface, and the comparative value, is expressed in British Thermal Units lost per hour by transmission through them.

Stone	...	...	14.00	Brick work	...	...	5.00
Sand	...	...	2.17	Fir fibre	...	...	1.87
Brick dust	...	...	1.88	Coke dust	...	...	1.29
Chalk powder	...	...	0.87	Charcoal powder	...	...	.64
Wood charcoal, in powder	...	...	0.68	Straw chopped	...	...	.56
Saw dust	...	...	0.55	Wood ashes	...	...	.58
Coal dust	...	...	0.54	Writing paper	...	...	.84
Hemp	...	...	0.41	Cotton	...	...	.82
Sheep's wool	...	...	0.82	Dry air	...	...	.8

Iron transmits 280 units of heat per hour. Copper, 520 ; Zinc, 225 ; Tin 178, and cork only 1.15 units.

If mineral wool is used, care must be taken to pack it carefully, otherwise it will settle and destroy its effect. Woodwork should be well nailed to prevent displacement under the effect of packing. Tar, paper pitch, fine cinders, hair and felt may also be used with success. Pine should be avoided, as far as possible, owing to its offensive odour. Dry air is the best non-conductor and in all insulations the more air is enclosed between the walls or skins the better. The materials should be well dried before being put in and as effectively sealed against ingress of air and water as possible.

SCALES.

Deposits in the shape of sediment from water on the outside surface of tubes, and from oil on the interior surface, often get accumulated in the condenser and refrigerator coils. Such coatings are exceedingly objectionable as they lessen the conductive qualities of the coils and obstruct the free transference of heat or cold through the same.

All the coils should, therefore, be cleaned now and then with a brush on the outside and, at least once every year, live steam should be blown through the interior surfaces at a

sufficient pressure to remove the congealed oil or other obstruction.

PREPARATION OF BRINE.

A convenient apparatus for preparing brine consists of a barrel fitted with a false bottom, which can easily be done by fixing a perforated wooden board about 8" above the fixed bottom and fixing underneath about 6" high \times 1" thick strips of wood, in cross sections, short distances apart. The inlet of water is below this false bottom. A sheet of strong cloth, or thin wire netting, is stretched over the false bottom and the barrel filled with common salt. Water enters at the bottom and percolating through the salt, flows out at the top in a decidedly briny state. The out-let may well be supplied with a drainer to prevent chips, etc., passing with the water. As the salt dissolves more quantities of it should be shovelled in.

With due regard to a reasonable factor of safety to prevent freezing, the strength of brine should be kept as low as possible. The specific heat value of brine decreases as its specific gravity is increased and deposits of salt may also settle on the refrigerator pipes.

HEALTHY WORKING.

Apart from the stand-point of efficiency and regular out-put, which in themselves are of prime importance, it is desirable to see that a plant is running in a healthy order. It is difficult to lay down any definite instructions for guidance in this matter. There are many little signs which a person actually working a machine, alone, can learn by experience gained from day to day work. Many of those signs are so subtle as to elude definition in words but which a trained ear and a trained eye intuitively detects. But some of them may still be mentioned here.

In a healthy working of the apparatus, every stroke of the piston will be marked by an even vibration of the pointers on the pressure and vacuum gauges; the liquid refrigerating agent will be distinctly heard passing in a continuous

and uninterrupted stream through the condenser delivery valve.

'The temperature of the condenser will be about 15% higher than that of cooling water running from the overflow: and, the temperature of the refrigerator will be about 15% lower than the actual temperature of the brine being cooled.'—Wallis-Taylor.

The liquid regulating valve will get covered with a regular coating of frost.

If oil gets in the condenser and refrigerator coils, it will paint the tubes and interfere with the free interchange of heat and cold. When oil gets troublesome and succeeds in substantially reducing the efficiency of a plant, it would be well to empty the plant and flush all pipes with live steam and hot water. The oil will thus be entirely washed-off.

When the compressor stuffing box leaks or the joints on suction side of machine grow weak, air will find its way into the system. Its presence is detected by abnormal rise in temperature or by production of a sort of whistling noise. In this case air must be at once discharged.

AUTOMATIC WATER FINDER.

This is an apparatus, recently patented by W. Mansfield & Co., of Liverpool, to ascertain whether a subterranean spring of water exists under a spot where boring operations are desired.

The principle on which the instrument works is the measuring of the strength of electrical currents which flow between earth and atmosphere, and are strongest in the vicinity of subterranean water courses, the flowing waters of which are charged with electricity to a certain degree. Should a subterranean spring be present underneath, the needle of the instrument begins to move. If the needle remains stationary, it may be taken for granted that a subterranean spring does not exist.

The patentees claim that the instrument can indicate

the presence or subterranean flooding springs up to a depth of 1,000 feet. A plentiful water supply is a prime necessity in Ice Factories. If, therefore, the instrument is really what its patentees claim for it, it should prove useful in locating subterranean water courses when wells are bored in uncertain ground and in dry tracts.

THE FUTURE.

The wide range of industries to which the principles of refrigeration can profitably be applied is not yet generally known in India. As our people get to know more about the utility of this process not only as a means for the manufacture of Ice, of which we have already got a bit too much, but in the far more important aspect of a powerful agent for the preservation of the numerous articles of our daily food, this branch of industry is sure to come into greater requisition and develop itself into the same grand proportions as it has done in Europe and America. In a hot country, like India, the preservative value of artificial cold has only to be brought to the notice of the firms dealing in commodities which fall a ready prey to the ravages of time and climate, in order to commend itself to their earnest attention.

I regret that I have not been able to dwell at any great length, in this treatise, on the precise methods of cold storage, as, for one thing, I have no personal experience in this line. But I have subjoined in the form of an Appendix the temperatures at, and the time for, which some of the common food products could be expected to remain, under the treatment of this process, in a state of freshness. For purposes of ordinary storing a temperature of about 34° Farh. in the cooling chambers is just about right. A ton of refrigerating capacity may be taken as being sufficient to keep in the normally warm parts of India, about 5,500 cubic feet of space, tolerably full with stores, at a constant temperature of about 34° Farh., in continuous working for 24 hours, provided the insulation is proper and a plant of at least 50 tons capacity is in operation. For the sake of comparison it may be stated that

nearly three tons of refrigerating power is required to produce one ton of Ice in this country.

We will have to depend for a considerable long time on Europe for the construction and supply of our Ice machines, but, really speaking, there is no part of an Ice plant which cannot be made in India. If larger manufacturing firms of the standing of Burn & Co. of Calcutta, have not yet turned their attention to the construction of this class of machinery it is probably due to the general ignorance about detailed information as to dimensions, etc., of the different parts of the machinery. But with the increase in demand a spirit of investigation will, it is expected, naturally assert itself.

The most difficult part to make in an Ice machine is the gas compressor. I am glad to be able to say that a compressing pump cylinder, recently made for an ammonia Ice machine by Bhana Mal and Gulzari Lal, of Delhi, to replace one that got broken, has proved quite as excellent and true as the one originally received with that machine. A member of the firm of Ardeshar & Co., of Amritsar, sometime ago told me that some Ice Cells and Plates made for them by Balmer, Lawrie & Co. in Calcutta are working just as satisfactorily as those imported from Europe. It is now more or less a common practice to make Ice Cans locally. The manufacture of Condensers and Refrigerators should not, if undertaken, present any constitutional difficulties.

These instances of local manufacture, though insignificant in themselves, would at least serve to show that the ice is broken and a beginning has been made. There are no doubt many a serious obstacle to be yet overcome, but if the feeling of restraint and hesitation is got over the rest will be easy of accomplishment.

A great difficulty in the way of success lies in there being exceedingly few persons, if any at all, in the trade that are conversant with the scientific basis and principles of refrigeration and the minute details of their application to the art

of commercial mechanics. Until this want is, in some measure, removed, we cannot be expected to make any head way.

PAX BRITANNICA.

It has rightly been observed by Sir Charles Furness that "what the commerce and industry of a country most of all need is a period of quiet and peace." We are grateful to Providence for having granted to us a period of quiet and peace at present and for having placed us in the guardianship of an eminently progressive Nation, from which whether in the excellence of public institutions and the high principles of Government, or in the superior standard of industrial enterprise and the greatness of commerce, we have not only already learnt much but under whose tender guidance we hope to benefit a great deal more with the march of time.

APPENDIX A.

Table showing Pressures and different boiling points of some of the liquids used in Ice Manufacture.

Tempera- ture of ebullition.	Tension of vapour, in pounds, per square inch.				
	Degrees Fahr.	CO ₂	Ammo- nia.	Ether.	SO ₂
5	340.1	33.67	1.70	11.76	
14	393.4	41.58	2.19	14.75	
23	453.4	50.91	2.79	18.31	
32	520.4	61.85	3.55	22.53	
41	594.8	74.55	4.45	27.48	
50	676.9	89.21	5.54	33.26	
59	766.9	105.99	6.84	39.98	
68	864.9	125.08	8.38	47.62	
77	971.1	146.64	10.19	56.89	
86	1085.6	170.83	12.31	66.37	
95	1207.9	197.83	14.76	77.64	
104	1338.2	227.76	17.59	90.32	
120	...	283.7	23.5	117.5	

—Ledoux and Lightfoot,

APPENDIX B.

Table showing properties of Brine prepared from common salt (Chloride of Sodium).

Percentage of salt by weight.	Weight of solution per gallon at 89 Fahr.	Specific gravity at 89 Fahr.	Specific Heat.	Pounds of salt per gallon of solution.	Freezing point of solution by Fahr. scale.
	<u>lbs.</u>				<u>Deg.</u>
1	8.40	1.007	0.992	0.084	31.8
3	8.68	1.023	...	0.256	27.8
5	8.65	1.037	0.96	0.432	25.4
6	8.72	1.045	...	0.523	23.9
7	8.78	1.053	...	0.617	22.5
8	8.85	1.061	...	0.708	21.2
9	8.91	1.068	...	0.802	19.9
10	8.97	1.073	0.892	0.895	18.6
12	9.10	1.091	...	1.092	16.2
15	9.26	1.115	0.855	1.395	12.2
20	9.64	1.150	0.829	1.92	6.86
25	9.97	1.191	0.783	2.485	0.5

APPENDIX C.

Value of Refrigeration as a preservative of food products.

The following data obtained as a result of actual experiments made in the Horticultural Department of the State Agricultural College, Kansas (*vide* Bulletin No. 84, April, 1899), shows the time for, and the temperatures at, which some common horticultural products could be kept in a state of absolute freshness in artificially cooled stores. A description of the packing, which has been found efficient, and is recommended, for use during storage periods is also given.*

TABLE.

Product.	Temperature, Deg., Fah.	Package.	Time.
Apples, summer...	38 to 42	Barrels or boxes	2 to 4 months
Apples, winter ...	32 to 35	Barrels or boxes	5 to 8 months
Pears ...	38 to 38	Barrels or boxes	2 to 4 months
Peaches ...	36 to 38	Crates	2 to 4 weeks
Grapes ...	38 to 40	In sawdust in boxes	6 to 8 weeks
Plums ...	38 to 40	Crates	2 to 4 weeks
Berries & cherries.	40	Quart boxes	1 to 3 weeks
Bananas ...	40	Crates	8 to 12 weeks
Lemons ...	40	Crates	8 to 12 weeks
Oranges ...	40	Crates	8 to 12 weeks
Figs ...	40	Boxes	8 to 12 weeks
Raisins ...	40	Boxes	8 to 12 weeks
Watermelons ...	40	...	8 to 6 weeks
Muskmelons ...	40	...	2 to 3 weeks
Tomatoes ...	38 to 42	Crates	2 to 4 weeks
Cucumbers ...	38 to 40	Crates	1 to 3 weeks
Celery ...	35	Boxes	...
Onions† ...	34 to 40	Barrels	...
Potatoes† ...	36 to 40	Barrels	...
Cabbages ...	34	Boxes	...

* The writer is indebted to Mr. Louis M. Schmidt for the particulars given in this table.

† Onions and potatoes, if in sound state may be maintained in good condition in cold storage for six or seven months. Onions should never be stored in the same room with other goods, and on their removal the room must be well scrubbed-out and white washed.—WALLIS-TAYLOR,

THE GOVERNMENT POLICY AND PEOPLE'S
 APATHY TOWARDS INDUSTRIES—COLONI-
 SATION OF MESOPOTAMIA BY INDIANS.

BY PAUL PETER PILLAI, ESQ.,

Bar-at-Law, Madura.

The agricultural, industrial and commercial prosperity of a country, giving the people varieties of occupation and sources of livelihood, are the greatest securities of life and property. This ensures far greater amount of security than all the extravagantly costly army of Police force and Military troops and highly paid Magistrates and Judges could give, as illustrated by the history of Bengal before its occupation by the British. "From another authority we have an account of the people of Bengal under its native Sovereigns, which we should be disposed to regard as fabulous if it did not come from one who had been long resident in the country, and who spoke from an intimate acquaintance with his subject. "In truth (says Mr. Holwell), it would be almost cruelty to molest this happy people; for in this district only are vestiges of the beauty, purity, piety, regularity, equity and strictness of the ancient Hindustan Government. Here the property as well as the liberty of the people, are inviolate. Here no robberies are heard of, either public or private."

If anything is lost in this district, for instance a bag of money or other valuables, the person who finds it hangs it on the next tree, and gives notice to the nearest chowkey, or place of guard; the officer of which orders immediate publication of the same by beat of tom tom, or drum." This state of things which is a great contrast to things subsequent to the British occupation up to the present day may appear fabulous, yet it is true as described by Holwell himself the Governor of Fort William who was connected with the Black Hole incident. It is not inhuman nature for one to resort to dishonest and violent means of earning livelihood fraught with difficulties, personal risks and dangers while honest and fair means of subsistence are

available. Lord Clive characterised the Government of Bengal under the East India Company as "anarchy, corruption, and extortion." The Government and its officers were condemned alike. The high officers, the Governors and Governor-Generals, with a high sense of moral responsibility denounced the Government and the administration in the strongest terms.

The material prosperity during the Hindu and Moham-
medan rule secured the blessings of good rule and security of life and prosperity, attaining the highest end of the Police administration and of the administration of Courts of Justice. Sir T. Munro "in his minute on Police administration recommends the increase of the prosperity of the people as the best method of reform. In the absence of material prosperity of the people agriculturally, industrially and commercially and in proportion to the poverty afflicting a people, crimes will be on the increase. The increase of crimes leads to the increase of police officers and the military force and criminal courts, giving the plea for division and increase of Provinces and districts. With all the vast army of the Police and military, the security arising from a prosperous state of things cannot be realised. Instead of improving matters there will be further ruin and devastation and very heavy expenditure to the Government at the expense of the people. When the administration grows defective, the hardships and ruin of the people are further aggravated and intensified. There is no credit at all to a Government, while with one hand, by faults of omission and commission, industrial and commercial occupations of the people are ruined, while with the other hand protection is offered against crimes.

The Industrial and commercial prosperity of a country is the most effective preventive against famines. By destroying commerce and industries in the hands of the Indians, money is drained and the income that the people could derive is lost to them and goes to a foreign country, and agriculture is the only resource left for the people ; and agriculture itself de-

pende for its success upon the ryot being well stocked with money and the necessary resources. Penniless and resourceless the ryot is carrying on his occupation in a languid manner, and agriculture under this state of things may be said to be in a decaying condition, as Lord Cornwallis himself said a hundred and twenty years ago about Bengal. The agriculturist leads a miserable life in ordinary seasons, and when seasons fail at the first touch of distress, he collapses and famine comes at once. Famines have become frequent and virulent in a manner unprecedented in history and in any age and country. There were 18 famines during twenty-five years of last century beginning from 1875—1900. These eleven years subsequent to them may be said to be famine years. This year a most dreadful famine has visited the country.

Sir John Shore with his extensive knowledge of the country and with an earnest Christian love of justice, said in 1787:—"The company are merchants as well as Sovereigns of the country. In the former capacity they engross its trade, whilst in the latter they appropriate the revenues, the remittance to Europe of revenues are made in the commodities of the country which are purchased by them." This commercial policy has been the principle of the Government all along. Shortly after the occupation of Bengal troubles arose over the monopoly of trade enjoyed by the East India Company and its servants, their goods passing through the country free from inland transit duty of 20 per cent. *ad valorem* levied on Indian merchants. Nabab Mir Cossim's endeavour to equalise the inland duty and save Indian merchants from ruin and extinction was resented by the East India Company and war was declared in which the Company had an inglorious victory. Trade came into the full monopoly of the East India Company which bought things cheap and sold them dear. It is chiefly to this that the severity of the dreadful Famine of 1770 was to be attributed. As Indian merchants were destroyed, Indian manufacturers also were destroyed by prohibitive restrictions and highly prohibitive tariffs. Silk

manufacture was discouraged and destroyed and so was cotton manufacture which was taxed an enormous *ad valorem* duty of 81 per cent, in order to protect British manufacturers. Other manufactures also began to decay. Shipping trade in the hands of Indians was in a flourishing state. The British merchants in their jealousy of Indian merchants who were carrying on extensive sea borne trade brought their influence to bear upon Indian rulers to discourage and destroy Indian trade. Marquis of Wellesley, when Viceroy, opposed the movement, but he was powerless. On the invention of steam and cheap labour-saving machines, the protective duties were done away with and gave place to free trade which was a protection to British manufacturers. The destructive processes were so great and were so successful that according to the philanthropic economist, Mr. Montgomery Martin, who said at the beginning of the last century that India had ceased to be a manufacturing country and became purely an agricultural one. By the destruction of Indian commerce, manufacture and the excessive drain, according to Lord Cornwallis the poverty and wretchedness of the people were increasing and he introduced the permanent settlement in Bengal in order to save agriculture from decay.

Hardly the blessing of permanent settlement was introduced in Madras, from 1802—1805, there arose a new class of politicians who opposed Indians growing wealthy and influential on other grounds than commercial. The creation of Zemindars in Bengal under the permanent settlement did not awake the jealousy and opposition of British capitalists as their existence was not opposed to their interests. The views of the new class of politicians are expressed in a minute by Thackeray, a senior member of the Madras Board of Revenue in 1907 who said :—
 “ That haughty spirit, independence, and deep thought which the possession of great wealth sometimes gives ought to be suppressed. The nature of things, the past experience of all Governments renders it unnecessary to enlarge on the subject; we do not want generals, statesmen and legislators; we

want industrious husbandmen." The Zemindars that survive the prosperous merchants and manufacturers who were crushed out of existence by the policy of commercial jealousy are opposed by the ruinous policy of Thackeray, which was opposed to Indians being raised to high offices of the State which were the monopoly of Europeans. The prejudice against large and prosperous land-holders has been manifested in all possible ways. By the land laws in the Punjab the formation of landholding classes is discouraged. The settlement of Taluqdari estates in Oudh and the Inam estates in Bombay and Central India in 1855 was a clear manifestation of the dislike to Zemindars. Even the Courts of Justice, as if imbued with the policy of Thackeray, declared the alienability of impartible estates governed by Hindu and Customary law and the Wakf estates under Muhammedan law. Without law and without precedent, decisions were passed by the Privy Council against established law by which large estates break up. The creation of Zemindari or large estates is an effective remedy against decay of agriculture as discovered by Lord Cornwallis. In my series on Indian Famines I have been advocating the creation of and the springing up of new classes of landholders with virtual permanent settlement on condition of irrigational and other improvements. At State expense or with grant-in-aid recommended by the Irrigation Commission, under such landholders there is a large scope for improvement by diverting the numerous jungle streams in the Western Ghats and in the hills to the North East of India as suggested by the General Secretary to the Industrial Conference in his address in 1908.

Thackeray would tolerate none but industrious husbandmen. Peasant proprietors are no economic advantage to any country and particularly so to India. Agricultural industry in which the ryots are engaged is very injuriously affected by the policy and principle under the new fangled mischievous theory of Nationalisation enunciated by Lord Morley in his Budget speech in the Parliament, where he said that

Irrigations, Forests and Railways in India have been nationalised. This announcement elicited cheers and applause among the radical members who could not understand its evil effects. The nationalisation of irrigation gives undue power to the Irrigational officers to the injury and annoyance of the people; only those acquainted with agriculture can realise this. By *nationalising* Forests, the Government has extinguished the immemorial rights of the people over unoccupied lands and the ryots have been ousted from the user by Forest Law. They have been deprived of the right of pasture for their cattle. The maintenance and breeding as an industry have been checked. Use of manure for fields, wood for agricultural implements and every thing within unoccupied lands necessary for agricultural and domestic purposes has been taken away and cannot be enjoyed except on permit and prohibitory restrictions. Cattle and sheep and live stock which form a good source of wealth and necessary accompaniment of agriculture have considerably deteriorated. Several parts of India suffer from shortage of bullock labour necessary for ploughing and draught purposes. Sir H. S. Cotton with his accurate knowledge of India, denounces the anomaly of an alien Government holding the theory of nationalisation of these things.

The heavy drain of money and the impoverishing effect have been admitted by all from the first period of British occupation by Mr. H. Verelst the Governor of Fort William, Sir John Shore, Lord Cornwallis, Mr. Montgomery Martin down to the present day. Marquis of Salisbury calls it "bleeding" of India without any equivalent. But drain by Railway is not readily admitted. Railway loans are raised with guaranteed interest which must be paid interest till the Railway is in working order. The high salaries of Europeans employed have to be paid. After the Railway is brought to working condition and if the incomes are not sufficient to cover the guaranteed interest the difference shall have to be made up. The materials for Railway are purchased in England for money paid there. Only a

fraction of the amount comes here. On account of the certainty of the payment of guaranteed interest the shares rise in value. When the Government purchases the Railway according to the stipulated agreements, it shall have to pay a high premium. After the purchase it is to the profit of the shareholders that the Railway stock should be converted into a loan bearing interest. The same company with same shareholders are given a long lease or contract to manage, receiving a substantial portion of the dividend in addition to the interest on the loan. This is a huge job. The high appointments in Railways are given to Europeans or Anglo-Eurians in preference to Indians. The Railway Board is entirely composed of Europeans. By Railway alone 50,000,000 Rupees goes to the Railway Companies from the people in the shape of fares. Drainage by other resources is estimated at another 50 crores. Lord Curzon during his Viceroyalty made it a policy to invite British capital. Sir R. N. Mukerji who presided over the Conference last year favours this idea. But it is very difficult for one who has the economic welfare of India at heart to subscribe to the views. There is the axiomatic truth expressed by Burk that every Rupee that an Englishman makes in this country is a loss to India. Raising foreign loans for Railways and irrigation should be avoided. These should be undertaken from the savings of Indian Exchequer. There is forestalling also in the field of industries, and if flow of foreign capital is unchecked by protective restrictions, all road to Indian enterprise will be closed. Then again the construction should be done with the materials in India. All Railway, D. P. W. contracts and contracts for civil, military stores should be given to Indians preferentially when available. Against enterprises where there is no competition with Indians, as in case of mining industries, there can be no objection. With the money drained and acquired from India the British capitalists have been enabled to largely monopolise the commerce and industries of India. It is not the British capitalists but the poor Indians that needs encouragement. It has been said that Railways are useful for

purpose of famine relief. Famines are much more frequent and virulent now than before. Previous to the British period there was no distress merely for want of ready communication and locomotion. The British merchant and capitalist derive the economic benefit of development of trade, while the pauper millions of India, who use the railways for money wasting and not money making purposes get easy locomotion, and a small number are benefitted by the receipt of cooly wages.

We are loyal to our Sovereign and we accord welcome to His Majesty with great zeal and enthusiasm unparalleled anywhere else. We respect and appreciate the officers under the Sovereign. Personally the high officers of the State are among the best of men for their honesty, integrity and devotion to duty. But neither our Sovereign nor his officers are responsible for the policy that has been pursued. They have been defending the cause of the people. Lord Minto while in India and after his retirement urged the necessity of having some protection for the development of its industries. According to him the Industrial and economic problems are the most pressing questions of India. Every Provincial Government has been doing its best for the cause of its Industrial development. The Industrial Conference held at Ootacamund three years ago was most conspicuous for its thoroughness and devotion. Its proceedings were marred by the dissenting vote of members representing the European mercantile community. The Secretary of State for India decided in favour of the dissenting members and the whole proceedings of the Government have been vitiated. One of the results of the retrograde step of Lord Morley was the abolition of all the technical institutes and schools in the Madras Presidency this year except one. These have been in existence for some years. Even the one retained is worked in a slovenly and languid way. All this is due to free trade principle. With the cry in all civilised countries we ourselves earnestly pray for extended technical education and the abolition of it in India is something most extraordinary. That

the Liberal Ministry with Lord Morley as the Secretary of State, should be responsible for this scandal is simply inexplicable, except that India should be ever subjected to economic supremacy and control of Britain. Nothing short of economic independence in internal administration would remedy this disastrous state of things. While the East India Company had delegated power to the Government, the British Parliament acted as buffer between the rulers and the ruled and instituted enquiries into the administration of the country once in 20 years. The Company's Government was abolished and the administration came directly under the Crown in 1858. The British Parliament has been refusing to make enquiry into the economic condition of the ryot and the repeated prayers of respectable and influential men were rejected, though India has had the distressing famines more frequently than anywhere in the world. Famine has become a permanent evil. We owe our loyal allegiance to our Sovereign and his officers, but we cannot own those plutocrats, who without any responsibility of the administration, force their commercial policy and ruinous exploitation on the people of India. They have no integral share or part in the administration.

Every country in the world and every British colony adopts protective policy as regards their industrial and commercial concerns. Protection may be by prohibitive tariff and even by free trade as in case of England itself in its commercial dealing with India. The imposition of countervailing duty on cotton manufacture in India illustrates the narrow minded and selfish and destructive commercial policy of British capitalists. India wants protection. To deny protection and to continue the destructive policy is a veritable anarchism. Need for reform in this is felt everywhere. The relationship between Indian Government and the British Parliament which has been condemned for its apathy and neglect of its duty to India by Mr. Montagu himself in his Budget speech needs re-adjustments. Even Sir K. G. Gupta of the India Office with knowledge of its

shortcomings demands colonial system of Government for India. The anomalous and irresponsible control of India by the British Parliament cannot be better expressed than in the words of the Under Secretary: "But apart from this, when I ask myself the question, what is the present attitude of this House towards Indian question? I am bound to answer frankly, that the salient characteristic of that attitude appears to me to be—speaking of the House as a whole—something approaching apathy. * * * * It is, of course, a truism that in Parliament acting through its servant, the Secretary of State is vested the supreme control over the Government of India. It is no less a truism that it is the duty of Parliament to control that Government in the interests of the governed, just as it is the duty of Parliament to control the Government of the day at home in the interests of the people of these islands. This House in its relations to India has primarily to perform for that country the functions proper to an elected Assembly in a self-governing colony.

By the reform, the necessity of which is admitted on all hands, the financial embarrassments will be removed, the industries and commerce in the hands of the people will be protected and developed and the increasing agricultural distress and famine will be relieved, and discontent and dissatisfaction will be replaced by contentment and satisfaction. All the evils will begin to disappear with the reform as if by magic.

Lord George Hamilton, the former Conservative Secretary of State for India said in his Budget speech before this Parliament in 1901 :

"I admit at once that if it could be shown that India has retrograded in material prosperity under our rule we stand self-condemned, and we ought no longer to be entrusted with the control of that country." All colonies are given economic independence. They resort to protection and enjoy utmost freedom to tax themselves and their exports and imports any way they like. They are prosperous for this reason. England is carrying on a prosperous trade with its prosperous

colonies. It would be in the highest self-interest of Britain that India should grow prosperous industrially and economically, so that it might carry on a prosperous trade with the millions of the peoples of India with larger purchasing power than now, as in the case of Canada.

APATHY OF THE PEOPLE TOWARDS INDUSTRIES.

Apathy of a people to their improvement generally arises from the depressed condition to which they are subject and to the consciousness of their paralysed and helpless state. Whether rightly or wrongly this feeling is most natural. Agriculture itself is developed by the Industrial and commercial prosperity of the people which act and react upon agricultural classes beneficially. In the highest interest of agriculture itself it is very necessary that endeavours should be made for the development of the industries of the country. Agriculture is the sole means of occupation for the people ; for the educated and enlightened community they have public service and learned professions as the only field of enterprise which is extremely limited in its scope and extent. When agriculture fails by bad seasons there is a widespread disaster and practically whole populations are thrown out of employment and occupation and means of livelihood. Industries do not suffer from vicissitude of seasons and they form the best mode of relief during seasons of distress. The only economic salvation lies in the development of India's industries as H. H. the Gaekwar of Baroda remarked in his presidential speech at Ahmedabad in 1902. Handicrafts by individual means and efforts have died out and they have to give way to organised industries by factories under joint-stock system. Every one has to feel the imperative necessity of developing the industries of India not only as economic salvation of the country, but also for protecting ourselves from unequal and crushing competition of foreign capitalists. Already the foreign capitalists have captured several industries in India, and, unless we look sharp even the few industries in our hands will pass into the hands of foreign capitalists, and we

shall become subject to the destructive law of survival of the fittest.

We should consider it to be the sacred duty of every one of us to see that the industries are developed in the best manner possible. In spite of the general poverty of the country there is sufficient capital required for the development of the industries, and there are sufficient men also in the country who could devote their energies and utilise their influence towards its industrial regeneration and salvation economically through this means. Alas there is a considerable amount of apathy over the subject which forces its necessity upon us in an increasing degree.

The Native Princes of the country and their ministers are in a most advantageous position to encourage the development of the industrial resources of the country in general and of their territories and subjects in particular. It is in the power of every State to start industries from the State fund as done by H. H. the Gaekwar and then make it over to private management. While Native States often burden themselves with concessions for foreign capitalists as in case of Railway and mining companies, they can with great advantage and profit to themselves and their subjects give every possible help to industries in the States. Grant to industrial companies should be the first charge upon their States as agricultural loans and Tukkavee advances are given to ryots; in the same way industrial loans and advances might with advantage be made on proper securities. The Sovereign princes themselves and their wealthy and influential relations in public and private can take part in the industrial development of their respective provinces, with their resources. The Government, that is most progressive and most advanced as regards Industrial and commercial developments of the subjects, largely resorts to bounties and subsidies in encouraging industries; and it is more than repaid in the shape of increased prosperity of the people and the increased revenue to the Government directly or indirectly. The Native States by encouraging industries

within their territories highly enrich themselves. They should consider that the wealth of the subjects is the wealth of the Government. A spinning Mill of 25,000 spindles means daily employment and wages for 2,000 people and 5 lacs of Rupees of local disbursement of all kinds, whose capitalised value at 5 per cent. will be a crore of Rupees. A State with such a mill should consider that the territory has had an accretion of one crore of Rupees worth of property. The advanced States of Baroda and Mysore hold out encouragement for the development of industries. The help they give is often of the nature of bounty and subsidy. The example of these rulers and their Dewans might be followed with advantage by other States. A Native State has several advantages over British tracts in that they are not bound by tariff and other restrictions and they have great latitude in dealing with concerns in their territories. They make investments for a short or long term out of the surplus and out of the funds in its trust as in case of Devasthanam funds. Instead of investing their money in Government securities and English Banks which go to the benefit of British merchants and manufacturers and in shares in British firms, it would be more to the interests of the country and the people that the investments are made in industries on loan system. In many instances as in the case of the Madras Tramway Company owing to a difficulty in supplementing short deficiency in working capital, the enterprise fails. Had our countrymen a little more enterprise the Madras Electric Tramway Company would have been in the hands of Indians. Such a deficiency can be easily supplied by Native States. Loan for working capital on the security of the proceeds of a firm under the control of the money lender for the rate of Bank deposits is the best and safest kind of investment. This loan will save many a Firm from collapse. What if a State with large income sacrifices a trifling portion of it in the interests of the industrial development of the country. It is a happy thing that there are a number of Native States in this country. If they

turn their attention to the development of industrial resources of the country they will not only confer a great boon on their own subjects, but also will exercise far reaching influence on the economic condition of the people in British India as regards their industries.

In British India, in Bombay and at Lahore the people are in advance over people in other parts of India in their industrial enterprise and in their spirit to combine and organise. Except in certain firms, even there the generality of firms suffer the same difficulties as in other parts of India. There are Zamindars with decent annual income who have much superfluity of money by their saving. There are lawyers and gentlemen of learned professions who command decent income and leisure to devote their labour and attention to the industrial regeneration of the country. There are officials receiving decent salaries commanding great influence in society. There are money-lenders and merchants who command money and deal in banking business. There are individual ryots also who under favourable circumstances command money.

Though the generality of the people are extremely poor, yet a portion of them especially those ryots who cultivate cotton and other industrial crops and who deal in them make much money. It is not for want of money that our existing industries languish and decay and that it is difficult to start new industries. It is due to sheer apathy, and want of patriotism to advance the economic condition of the country that Indian industries suffer. There is hopeless infatulation and helplessness in our countrymen when even well-to-do gentlemen say that they are not rich to subscribe for share, that the company's business is at some distance from the subscribers' place say 250 miles, that they subscribe to other charities, that such and such business failed, and that our people are not able to manage business. Shares are of small value and it does not speak well of the spirit for a well-to-do person to plead his inability. Distance of place of business is no bar for one subscribing to the

shares. We have to learn a good lesson from Europeans and Englishmen as to the way and spirit with which they carry on their monetary and industrial business. Capital accumulates from comparatively poor subscribers. Even humblest widow feels that her spare money is bound to find investment and get dividend. The Englishmen have enough of men like Jabez Balfour who was convicted and imprisoned for fraud in trade and in joint stock companies. They suffer risks by failures of business. Yet they risk. Their success in business is in proportion to the courage with which they incur risk and their business habit to guard against risks. The Company Act is a great help with its rules for forming and organising companies. As the Director of Industries said in the meeting of Industrial Conference at Kurnool in proportion to the strength of the organisation, the personal element has no scope in business matters to their interference. Every thing is organised and systematised so that a business concern is managed in an automatic and machine like manner. The rate of wages, the rate of price of raw articles, and the manufactured goods are well known, and there is no reason why things should go wrong. The success or failure of a business depends upon ourselves, and in registered joint stock companies the control is in the hands of the Directors. Law expects of them ordinary diligence and care which are sufficient for success. Investments on industries will be the best kind of investment. We are in the habit of spending money on jewels which is worse than hoarding and which leads to many evils. We are lavish in our expenditure on marriages and on domestic and religious ceremonies. Even in matter of investment there is undue pressure on lands raising its value by keen competition. The value of agricultural lands has risen to Rs. 5,000 per acre and upwards yielding a very poor dividend on the money invested. The high price of land which is called unearned increment does not add to the wealth of the country by a sing pie. It is a misfortune that so much of the wealth of the country should be locked upon land. In former periods people used

to bury their money in the land, now they bury it on the land. Investment on agricultural land is attended with thousand and one difficulties and with serious risks, while shares in companies are easily procurable, transferable and the business is easily manageable under good managers and directors. Money lending by Co-operative Banks and other Banks for the mere purpose of money lending equally does not add to the wealth of the country. Mere hoarding up money and investment on European Banks and Government Security does not improve our position in any way. The unemployed problem is a very serious one, and if our countrymen be indifferent and apathetic about it, we have to face a most serious danger. When the remedy lies with us, there is no use of attributing the evil to the Government or Europeans. A number of our countrymen are enterprising and patriotic enough to collect fund to help Indian students to go to Japan, Europe and America to qualify themselves for some industry like paper-making, glass-making, pencil-making, mechanical and electric engineering, metallurgy, etc., but they lack all zeal and enterprise to help the industrial development of India not only by starting new industries but even in supporting the existing ones. There about 232 cotton mills and 1,500 factories of all kinds worked by mechanical power in India. A large portion of them are in the hands of Europeans who manage their business successfully, and in the Madras Presidency they realise a dividend of about 20 per cent. provided the price of raw cotton is favourable. There is no reason whatever, why Indian companies should not manage their business with equal success, having several advantages over Europeans: I know that certain Englishmen feel very much for the success of Indian industries more than Indian gentlemen of means and influence feel for it.

To illustrate the superiority of Englishmen over us in their appreciation of the value of money and in their honest eagerness to find investment for it, I would refer to a prospectus of the British Burmah Rubber Plantations Limited with

capital 100,000 £ divided into 100,000 shares of £ 1 each. The subscription lists would open on Monday the 24th day of April 1911, and close for London on Tuesday the 25th day of April 1911, for the country and the continent, the 29th day of April 1911. Only single day of 24 hours is given to the London subscription and only 4 days for the country and the continent. This short period is given to avoid the trouble, inconvenience and labour of rejecting applications for subscription beyond necessity. When I was in London in 1902 Sir F. Lipton advertised for shares for a company with a capital of 2½ millions sterling. In a week's time the shares were subscribed twenty times over. The difficulty was in accepting the shares that were subscribed first and rejecting the shares which were applied for late. Two old widows who were my landladies at Russel Square, London were among the disappointed subscribers. It is humiliating for Indians that Englishmen and Europeans should feel that the first charge upon their spare money is investment on industries and on reproductive concerns however poor they may be, while we are negligent about the sacred calls. Shares are readily forthcoming in 24 hours after the knowledge of the advertisement often from poor people for a concern that was to come into existence in the future, whose prospects are uncertain in a distant place 10,000 miles away by water from the shareholder's place. I know of instances where you may advertise for shares in all public journals and personally canvass from one end of the year to the other. Let the factory or business concern be in full working order with plants, tools, buildings, grounds and other assets be ever so valuable, more valuable than shares advertised for, all these considerations are of no avail. Registered Companies have a nominal capital of 140,000,000£, with 80,000,000£ of paid up capital. Of this Indian share of capital is 40,000,000£. Foreign Registered capital for business carried on in India includes Debenture capital. Industrial business largely carried in India is managed by British capital. Indians enjoy only the humiliating advantage of

receiving cooly wages. Even for the remaining portion of the Industries several of which are conducted in a languid manner for want of adequate capital, if British capitalists are anxious to purchase Indian industries and if Indians are disposed to sell them, in a week's time capital can be raised in London in order to make short work of Indian Industries and to bring all industries under the monopoly of English capitalists.

COLONISATION OF MESOPOTAMIA BY INDIAN.

Relief for the famine-stricken and poverty-stricken India is urgently needed. It had 18 famines during the 25 years from 1875—1900 and every year since the dreadful famine of 1900—1901 may be said to be a famine year judging from the prices of articles of food as prescribed by the Famine Code and from the growing shortage of the outturn of food crops. As development of industries is a very effective remedy for distress and famine by giving work to a large number of people whose occupation will be affected by vicissitudes of the season. Emigration is another effective remedy as recommended by the Famine Commission of 1880. Emigration from congested parts to uncongested places is not without difficulties as all unoccupied lands are the property of the State without whose permission no lands could be occupied. There are the vested rights of the previous occupants in these areas. Favourable terms of occupation, favourable seasons and favourable agricultural and economic conditions should be considered. Emigration to foreign places has been resorted to by labourers and coolies, by merchants and by men in public or private service. When these settle in the parts to which they had emigrated they become domiciled and naturalised and engage in different occupations. Emigration to British colonies has been discouraged and opposed; and if allowed, it is on prohibitory and most degrading conditions. Excepting Burmah which has become part of British India, the people of this country have not emigrated to other places as independent agricultural colonists.

Since my return from my visit to Turkey, Palestine and Syria in 1902, I have been urging the colonisation of Mesopotamia by Indians as a great relief to Indians from their present poverty-stricken and famine-stricken condition, Mesopotamia with more than 100,000 square miles extending from the foot of the Taurus Mountains to the Persian Gulf offers the best field for colonial enterprise. Watered by the two large rivers, the Tigris and Euphrates with a fertile level soil, Mesopotamia will be a rival to Bengal and Egypt. According to the description of Sir William Willcox, the Engineer employed by Turkish Government in constructing works for irrigation in the Province, there are three millions of acres in swamp and the remaining portion are a desert. With the extension of irrigation, cultivation could be extended. With rainfall like that of Scinde and with climate subject to the extremes of temperature as in the Punjab, every variety of crop could be raised with an abundant yield. With the exceeding fertility of the soil and with abundance of water carrying rich alluvial deposit, if well cultivated and irrigated, according to the estimate of *Encyclopaedia Britannica*, "The country, could support five hundred times as many inhabitants as it actually contains." There are settled inhabitants in a few towns like Bagdad, Mosul, Karbela and Bosra. If the whole population of settled inhabitants in Mesopotamia be estimated at 600,000 a little over the population of Madras the productiveness of the country will be sufficient to maintain thirty crores of people, *viz.* nearly the present population of all India.

Colonisation of Mesopotamia where famine will be unknown according to its conditions will be a great relief to the famine-stricken and poverty stricken people. It will be a great feeder and support for India. Irrigation water will always be available throughout the year, and there will be no fear of destructive floods. With the construction of the Euphrates Railway by the Germans and the proposed construction of another railway by the English from Port Said through North Arabia, Mesopotamia and Central Persia, and with the con-

struction of irrigation and navigable canals, the means of communication will be very great and highly advantageous. Mesopotamia will have a commanding central position for the purposes of trade.

Irrigation water and Railways are great civilisers and the Bedoins and Khurds will come under the civilising influence and will betake themselves to peaceable occupation. Under the Turkish Government a greater security prevails than before. When the colonists go in large numbers, this itself will be a great security. There are no jungles to clear and no previous settlers in these desert and swampy regions to dispute the title of the Colonists as is the case in all British Colonies. The Turk personally is amiable and polite and he will be happy to share the land with Indians. But the Turks being the ruling race with the responsibility of the Government are required for the army, military service being their chief attraction. The Government has been reformed on constitutional lines and there will be no difficulty in obtaining self-Government in a modified form like the self-Government given to the Drusus and Maronites of the Lebanon District. The Turkish Government has begun the construction of irrigation works. The work is slow on account of the paucity of labour supply. Sir William Willcox the Engineer in charge of the works proposed to import Indian labourers, who will become the ryots of the Turkish Government. One great virtue the Turk possesses over European rulers, is their dealings with subject race. He is not commercial and does not enter into commercial competition. While there is so much bright prospects of colonisation of regions in the neighbourhood, why should we allow our countrymen to suffer under the mean and degrading treatment in distant places like Canada, Vancouver, South Africa, Australia and Mauritius? The best remedy is to withdraw them and help them in colonising Mesopotamia. The colonials are entirely benefited by Indian labourers but they would not tolerate them as independent and free citizens. It is desirable that not only labourers but better classes

and capitalists also should emigrate and co-operate with the Turkish Government in developing the irrigational and agricultural resources. With very large resources we cannot find a better place for emigration. For combined work of maintaining irrigation works and cultivating irrigated crops we want a large number of people. India alone can supply this need of Turkey, according to Rev. Dr. Zwemmer of Behrin the author of "Arabistan." The colonisation of this most fertile region full of unfailing agricultural capability and resources must stimulate the enterprise of our countrymen. These regions, the site of the Garden of Edan, and the seats of the Babylon and Assyrian Empires, and the eastern Caliphate of the Saracen are most classical and most attractive and fascinating for this reason to the Aryans, Mohammedans, Jews, Christians and Parsees. Reports may be fascinating. But it is necessary that some three or four gentlemen might be deputed to make local investigation and arrange about colonising the regions and an association should be formed early for such purposes. These regions from time immemorial have been associated with India as the trade route to convey Indian merchandise to the west by caravans. There is considerable trade now with India and there are a number of Indian merchants resident in those parts. I draw the attention of the Industrial Conference to this subject. The colonisation will be a cure to many ills under which India is suffering, like food famine, fuel famine, fodder famine, cattle famine, money famine, and often water famine, which all increase in extent and intensity, without hope of relief under present circumstances.

INDIA'S EDUCATIONAL OBLIGATIONS.

BY S. D. SAKLATVALA, ESQ., B. A.,
Empress Mills, Nagpur.

The subject of Education in general is itself of such a far reaching and important character that it has merited the attention of all nations from the beginning of early

civilization. Education, whether through the Home, the Church, the School, the Farm, or in the latter days the Workshop, has prevailed in one form or another in every land. A process of such a training has gone on from generation to generation and on the kind and amount of this training has depended the varying degree of ancient, mediæval and modern civilizations. But the subject is of vital importance to us in India and of profound interest at the present moment—of importance because there are still millions in the land steeped in ignorance and superstition and of interest in view of the Bill for extension of Elementary Education throughout the land proposed by that able politician, the Hon'ble Mr. Gokhale. The system of Education was one of the first problems to which the British devoted themselves when their supremacy was finally established in India, to the lasting benefit of the country. Since then the progress of Education has been fairly rapid, but at the same time it cannot be denied that the system of caste prejudices and other orthodox customs have retarded the march of Education in every department. Such retardation, however has been, though in a less measure, common to most countries now in the fore-front of civilization. In early days, Education chiefly took the form of religious education, and was to a great measure thus confined to the priestly classes. But in these countries the struggle for general education has already nearly ended, whereas in India it is yet only beginning. The utter indifference of educated classes till recent times towards the mass of the people, and our habit of relying absolutely on a paternal Government for every thing have also been greatly responsible for such a backward state as far as general Education is concerned. Some people even now seem to think that because India can boast of a glorious

civilization in the remote past, she need no longer care for the civilization of the 20th century. But such a basking in the sun of past glories will be of little avail, and now, that the Hon'ble Mr. Gokhale has made a start, is our opportunity. Let us then grasp this opportunity with a firm hand so that it may not slip through our fingers. Indeed it must be a matter of genuine satisfaction for every educated Indian that the question has been so earnestly taken up by a native of the country who understands the value of general elementary education and is naturally desirous of spreading it through the country. A system of education permeating all sections of Indian societies will alone uplift the helpless masses of our vast population. Such a system alone can give us better labourers, and better artisans. It alone will teach our little lads to think ; it alone will teach our men to be better citizens of an enlightened Government. In short, such a system alone will clear up the dense mental fog which now hangs over the land.

These views, I am fully aware, are not shared by all, but strange to say, a certain amount of opposition has manifested itself since the publication of the Bill. Therefore, before examining what India's educational needs are, and the means to legitimately fulfil those needs, it will be necessary to refute the objections commonly raised. It has been said (1) that the masses in India do not ask for such an education, nor do they want it ; (2) that India is not as yet ripe for such system of general compulsory education ; (3) that looking to her present conditions such an experiment should not be tried.

As regards the first argument it seems really too childish to be seriously controverted. How can the masses be expected to ask for a thing the value of which they

have not been taught to know. Surely the children whom we send to School never ask to be educated and from the fact that the children do not ask to be educated can we conclude that they do not require education? Next, those who say India is not yet "ripe" for such an education simply assert that India must still lag behind in the race and be content to remain for years to come in a semi-civilized state. Those who decry Mr. Gokhale's Bill on this score, really fail to appraise at its right value the importance of general education. Besides, waiting for "ripeness" is a dangerous game, because the next stage after ripeness is rotteness, and we might wait too long only to awake when too late. Nay let these men take up the question from a broad and liberal standpoint, and have before them the patriotic purpose of stimulating the march of civilization through their land. The third argument is equally vague. An introduction of such a system of education will necessarily involve a transformation of standards and such a change must be viewed on its own merits and not upon preconceived ideas or on existing relations only. The conquest of the air through aeroplanes will necessarily involve changes in the ideas of International Law which is bound to be influenced by the introduction of the absolute freedom of travel through air, but should we on that account condemn the aeroplane as not suited to our "present conditions". Such men fail to recognise that an altered condition of affairs is not to be judged by existing standards only, for these standards themselves will become modified in the end.

There is yet another objection, more real and based on more practical lines—on the ground of economy. The author of the Bill has sufficiently shown that the difficulties in this direction are by no means insurmount-

able. The cost at first sight appears to be tremendous but if properly distributed it will not fall so heavy as may be supposed. At any rate this question of cost should not hinder a modest beginning such as is proposed by this Bill. Besides, we can to a certain measure also place our reliance on private enterprise and private charity. Of late years much has been accomplished through private agencies in the domain of higher education and surely, it would only be reasonable to expect that the same will be done in later years for elementary education for the mass of the people. The chief industries of the land are certain to profit in the end by a free and compulsory education. The Textile Industry has under its charge more than ten thousand children, and it will not be difficult for each mill to voluntarily arrange for the training of these in elementary education. The example of the experiments made by the State of Baroda can also not be lightly passed over. The Government of India can command far greater resources, and if the educated classes sufficiently co-operate, the success of the scheme and the future of India will be assured.

This question of cost is closely allied with the question of State interference, for it is clear that if the State has to bear even a portion of the cost the State must have a proportionate control. It is really a delicate question as to what extent the State should intervene in educational matters. In the ancient world, the State was the universal educator prescribing the training of each citizen. The tendency in modern time, however, is that the less the State meddles in such affairs the better. But even in England itself this theory is more than modified by the proviso that no child shall grow up without acquiring at least the rudiments of learning. All advanced countries have provided in one form or another for a systema-

fic education of the masses of the people, so as not to be left behind in the race of life in competition with their neighbours. In India, owing to the peculiar conditions of the country the people in this respect depend on Government initiative alone. The educated classes have till recently done but little towards mass education. Under the present circumstances Government intervention alone can help the masses of our population. And we have not to go for a precedent in the matter of direct Government interference under similar circumstances. It is only lately that Government have passed the New Factory Act in the interest of India's labouring classes who otherwise could not have defended themselves against unearthly hours of toil. Government interference was rightly deemed not only to be justifiable but imperative. This question of elementary education, will, I trust, be viewed in the same light and protection afforded to the people in the same spirit by introducing free compulsory education.

There is also another class of people who do their best to prove that such a system of education, if introduced into India, would cause more harm than good. The gist of their argument, however, only tells the oft repeated story that as the East is not the trust we must have nothing to do with a Western education. Profound logicians indeed are those who argue in this strain. These people can never believe that there may be many things in common to the East and the West without which neither the East nor the West can make any progress.

These are the people to whom the disadvantages above seem to appeal and they love to dwell on these alone forgetful of the fact that it is even far better to lose a little if the corresponding advantage is to outweigh in a most decided manner this trivial loss. For every great

boon that we gain we must be prepared to lose a benefit which may be estimated as of a much lesser account.

We have now sufficiently cleared the ground for an impartial survey of the different kinds of education required for our country. It is of course not proposed in such a place to give the details of a literary curriculum or make out an elaborate programmer for a scientific training. We can only indicate the scope and usefulness of each sort dealing at greater length with Technical Education which alone comes within the true sphere of an Industrial Conference.

Education as we have already seen is a general term which naturally divides itself into the education of the home or domestic education ; that of the church or religious education ; that of the school or general education ; and that of the farm or the workshop or industrial education. These are the agencies through which education spreads among the masses. It is a continuous process handed down from generation to generation, if there is to be a continued progress of the people. A moment's thought will make it clear that in a backward country like India education must be enjoined as a matter of duty and must commence with the elementary education at the School.

For it would be most hopeless to expect the children to be at all educated at home when the parents themselves do not know what education is, and are only eager to send the little children to work so as to increase the family earnings. Any system of religious training for the masses is equally impossible when there are different races and when each race is divided into a hundred sects each professing different creeds. Technical or industrial education can also hardly be imparted with advantage unless the ground is prepared by an elementary education. Ele-

mentary education for the masses is then India's greatest need. Such education can only be of a general type as opposed to special education which can only be within the reach of a few. The aim of this general education should be the moral and intellectual development of the child. As already stated it is this primary or elementary education that is most needed and which is proposed to be introduced by the Hon'ble Mr. Gokhale's Bill, leaving the higher or secondary education as now for those classes who have the means and intellectual ability to acquire it. This simple system of education will not only give us better citizens, but also better ploughmen, better weavers, better brick-layers,—just as special education now gives us better engineers or better lawyers or better doctors. And surely it will be a great benefit to the country even if a few intelligent lads belonging to the lowest classes being trained by elementary education were to use not only their physical faculties but to exercise their memory and common sense, quick to read, write, and reckon—find themselves able enough to leave their humble occupation, and qualify themselves for a special education. A higher literary education combined with the experience and practical work of later life will certainly produce desirable results. There is of course an element of danger in over education, but should we on that account sit still and not even make a beginning lest we should bring in this danger some centuries hence? Just now a good deal of attention is being paid to this side of the country's literary education and let us hope good will result from the reforms proposed and already adopted.

Next we must turn our attention to the particular conditions existing in the country. The fact which stands forth most prominently is that India is an agricultural country, and next that it contains a

sufficiency of raw materials to convert it in part at least into an industrial country. For this purpose a special technical education is also a prime necessity. This kind of education may also be subdivided into higher, secondary and elementary. To take primary technical education first, it will be seen that an elaborate technical education to the great mass of the people would be an unpardonable waste of time and money. However in those primary schools where the majority of the students are afterwards to be employed in a particular industry we can with great profit combine elementary instruction in that industry with the general education. To make my meaning clear, children in the Mill Districts who are certain to be employed as Mill labourers when grown up, when acquiring the rudiments of general education may also be made familiar with particular tools and materials which they will have to handle later on. In rural districts a knowledge of the surrounding country with the different kinds of crops grown thereon and the utility of manuring etc. imparted to the children will be of great use to them when most of them turn out practical farmers. A little elementary drawing and designing will also be of great use in most cases. The first need, of course, is for every one to be able to read and write, but primary technical education on the lines indicated here will make the children get on easier and quicker and teach them to handle their materials and implements more carefully. Next secondary technical education is necessary for those who would become foremen and superintendents in most industries, as also for a few workmen engaged in delicate crafts. If these have received a preliminary grounding it will be easier for them to acquire the details with which practical work alone can make them familiar. Necessarily such an education must be confined to the classes enumerated above. Still

narrower is the sphere which belongs to the higher technical education. This sort of education is very essential for those who wish to gain success as large employers of labour. The sons of our employers of labour start in life without any rudiments of a technical education and depend entirely on the experience they might gain later in life. They complain of inefficient labour but forget that those whose duty it is to guide and direct labour are themselves incompetent. This incompetency on the part of our leaders will become still more apparent when a scheme of general elementary education has improved those classes from which we draw our work people. In this connection may be pointed out a practice which has become more or less common but which in the opinion of the writer is a mistaken policy. Much enthusiasm is displayed at present in sending out "deserving" young men to Europe to study some particular kind of industry. These men on their return are scarcely able to achieve anything. In the first place it is not always the "deserving" who are sent up and secondly those who are selected, study under totally different conditions and on their return they fail to apply their knowledge to the new environment which surrounds them in their own country. It would be perhaps a far better policy to employ the money now spent with but little gain, in calling out experts to India to teach different industries. Their superior knowledge and varied experience will soon enable them to master local conditions and they can then impart useful knowledge which is bound to produce beneficial results. The Tata Iron and Steel Works at Sankchi where every department is supervised by a European or American expert will soon turn out a capable and highly efficient staff of young Indians who will have the advantage of being taught by experts under local

conditions—conditions under which they will have to work always. This is I think sufficiently obvious and more need hardly be said. We might, however, add that the modern methods in all industries now require that a higher technical education in order to be complete must be combined to a scientific training. For this purpose the Indian Institute of Research now affords us ample means and opportunities as far as our immediate needs are concerned. We therefore seem to be better equipped in the higher domain of education and what remains *first* to be done is the imparting of the rudiments to the mass of our vast population.

We now come to secondary and higher literary education and here we tread on familiar ground. Indeed so far I think greater attention has been devoted to this side of education possibly to the neglect of others. The various reform movements in this direction now set on foot will no doubt bring about improvement, all that remains to be said on this subject is perhaps that the hundreds of those who have received such an education owe it to their less fortunate countrymen to endeavour to the best of their ability to spread throughout the country at least the elements of that very education which is their proud possession to-day.

Before we conclude we must if only in passing touch upon yet another subject of the greatest importance to the intellectual well being of our people, but which on account of the peculiarity of the social customs of Indian life is of a particularly delicate nature—I mean Female Education. We all know the importance of female education and yet in India we must neglect it owing to overwhelming difficulties created by a servile respect for time-honoured customs! No Government, no legislation can help us here; the people must

undertake the task as a solemn duty. It is really a sad commentary on the so-called educated classes that a large number of them should rest content to let their wives, daughters and sisters remain in ignorance. A good deal I admit has been done of late years but it is only a very small fraction of what remains to be done. It is really difficult to break through the hard crust of custom, but the day of change must come. "Let old order change and let every individual help the forward movement. The least that we can hope in this direction is that provision of the Bill proposed by the Hon'ble Mr. Gokhale will, if passed into law, be made applicable to girls as well as boys.

The field of education in a vast and backward country like India is so large that it would practically be impossible to traverse through the whole of it in a brief essay like the present. It is sufficiently made clear, it is hoped from the foregoing remarks that India's greatest need is a system of general elementary education freely imparted to as large a number as possible. The Bill so frequently referred to here gives us an excellent opportunity to make an effort—however belated—in the right direction we can only hope that this Bill which may be characterized as an extremely moderate one, when it emerges from the Viceroy's Council as an Act, will not have its wings further curtailed, for any further moderation will only be a serious fault. Moderation no doubt is always commendable specially in a conservative land like India, but too often what we call "moderate" reforms are only a temporizing with present abuses. A lack of enthusiasm and idealism is very often covered under the guise of compromise.

THE EDUCATION FOR INDIA'S FUTURE MERCHANTS, BANKERS AND FINANCIERS.

BY PROF. S. R. DAVAR, *Bar-at-law*

*Principal, Davar's College of Commerce, Law and
Banking, Bombay.*

In the present day World nothing looms so large as Commerce and the old prejudices against Commercial men and Bankers entertained by European Society are dead and dying. The spell of the learned Professions and Military Commissions which were once considered to be the only correct outlets for the activity of the educated sons of gentlemen is broken by the advent of the multi-millionaire, Merchant, Prince and Banker who has taken by force as it were his stand in all the social circles which were once closed to him. In India the same transition is apparent though very slow and all we want is to make it march much faster than it seems inclined to do.

The wonderful advance made by the Western-Nations in the Industrial and Commercial field is due to their specialised training and discipline which is the natural result of the former. In old days it was thought quite sufficient to place a young man in Mercantile firm or a factory to learn his trade but now-a-days such a course would produce very poor results as the condition of our old type of merchants clearly indicates. The businessman of the future would have to contend with the most enlightened races of the World which are themselves fully equipped with a specialised education of the highest order and the young Indian Merchant who wishes to be abreast of the times here as elsewhere cannot do better than receive proper Commercial Education.

We all know that as late as the middle of the nineteenth century, England had no rival worthy of its name

in the field of Commerce and in many industries it had the advantage of being the sole supplier of the World's wants. When therefore the other European nations thought of competing with such a powerful rival they, specially the Belgians, who deserve the credit of giving the World its first College of Commerce in 1852 and also the Germans, hit upon the plan of starting Schools of Commerce which were later on supported by the State and the mercantile community. In these schools the text-books used were written by various retired businessmen who recorded their experiences of lifetime in the particular branches of business to which they were attached. These have since been much improved upon and expanded. It was thus that the other continental nations made up for their lack of experience by a systematic education with the results known to us all. At first to English businessmen who had learnt business by working in offices and firms of their fathers or friends, this new idea of teaching Commerce at School seemed novel but they soon found themselves face to face with a competition from those nations that alarmed them. The Commercial World had much advanced by them and it was not very difficult to realise and admit that the old order must give way to new if England was to maintain its worldwide Commercial superiority. For example, it was hardly possible for a young man fresh from a local school to grasp the intricate mechanism of a business office which has some thousands of constituents all over the World, where imports and exports are counted by millions, which employs some hundreds of assistants and is divided into numerous departments and branch offices. All that the young man can do here would be that after years of hard work he would only be able to know a few points that come within the narrow sphere of his work and that too not quite

intelligently. He has therefore to acquire all knowledge about business in the first instance from books and lectures and armed with this preliminary education he can join any business with confidence and intelligently follow the work in actual practice. Some fifteen years ago the London Chamber of Commerce took the lead by appointing a special committee to formulate a scheme of education best suited to the rising generation of businessmen. The scheme thus recommended is the one under which the examinations in the various subjects of Commerce are held yearly all over the World by the London Chamber, where thousands of candidates appear. This scheme of examinations has succeeded so well that as per their latest communication the London Chamber has now made these examinations half yearly.

Besides this scheme of holding examinations for a general test of Commercial Education other schemes for specialised branches of this education such as for the Profession of Public Accountants, the position of a Secretary of the Joint Stock Company, Bank Management, Actuarial Work in a Life Insurance Company, etc., were also formulated. The Universities of Birmingham, Manchester and Leeds have also started faculties of Commerce and the London University is also considering the question. The Bombay University has also taken this matter up. So far the University examinations in Commerce have not been very successful mainly owing to their courses being more academic than practical and let us hope that our Indian Universities would not err in that direction.

It has been the general complaint both in India and England that young men educated in public Schools and Universities for arts degrees do not take to business very kindly. That they take to business only when they are

forced to and are always eager to get out of it as soon as may be. That they always prefer the learned professions. Here the fault lies not with young men, but the result is quite natural, because their liberal education develops their faculties in quite a different direction and a leaning to the literary line is the consequence. If on the other hand youngmen were to be left in business. Colleges soon after their first general education test—say the Matriculation or School Final—where education in Commerce would cultivate a taste for the subject of their study the result would be quite different. I would, therefore, urge the Indian parent who wishes his son to take to business to see that the boy is specially educated for business, and specially a merchant father who wishes his son to follow his line cannot do better than giving his son a sound Commercial Education, for not only would the young man readily take to Commerce but would be of great assistance in improving and expanding his father's business.

Let us not forget that some of the best and most powerful business houses both in India and Europe, had very modest beginnings and there is no reason why young Indians with their energy, industry and hereditary business talents and traditions, armed with a thorough Commercial Education, should not in course of time build up large business houses and add to the prosperity, prestige and influence of the race. Of course we are not all born with the Commercial genius of late Mr. Jamshedji Tata but there is no reason why we should not to a certain extent make up that which we lack with a scientific education. Besides men like Mr. Tata would be capable of doing much more if they had army of specially trained young men for Commerce to help them in their gigantic enterprises and thus open a glorious future for themselves and their country.

Let us survey the situation of our Indian Business World as we find it in Bombay Presidency which is more or less on par with the other presidencies of India. We know that there are numerous business firms conducted purely by Indian Businessmen where business worth lacs of rupees is done. Here in some cases the proprietors are men that have made their own fortunes by their own exertions but there are also other firms that owe their position to the exertions of some members of the past generation who died leaving the business to their heirs. These firms are generally managed by gentlemen known as Munims who are left in the entire control, whereas the principals are mere figureheads. These munims are also in many cases hereditary servants. These men run the business of their masters not quite disinterestedly for we know as a rule that though very poorly paid they have the marvellous capacity of building up large fortunes. The masters know little of business and in some cases careless. The staff of these firms generally are made up of a couple or more of Mehtas or Gumastas, each of whom is the firm's book-keeper, correspondent clerk, bill collector and resohia merged into one. Our merchants boast of this as economy. The idea of proper division of labour and its advantages are quite unknown to them. The mehtajis keep books which I know from my personal experience are accounts kept in the most primitive methods unnecessarily rendered complicated by entries and counter-entries so that it is only the mehta who understands them. Accounts are allowed to run on indefinitely without being balanced. The result is that the merchant is left entirely in the dark not only with regard to his own position as to profits that also as regards his own financial standing. Things go on like that indefinitely till a number of business reverses bring

the whole fabric down like a house of cards. The merchant goes on overtrading where he loses quite ignorant of the fact and he undertrades when he is really making profits. He is also at the mercy of his underpaid assistants who are not quite honest. His business does not expand beyond a certain limit for the want of proper organisation. If, on the other hand, this man had received in his young days a proper Commercial Education he would have appreciated the advantages of a proper system in his counting house and also of engaging properly trained men at their proper wages. He would also know how to keep checks and counter-checks to prevent fraud and misappropriation. He would have these accounts periodically closed and blanced and thus every inch of the ground he treads on would be clear to him. He would understand his responsibility and rights on every contract he has entered into and would be able to gradually expand his staff with his business. Commercial Education would teach him all the intricacies of Book-Keeping, all the etiquettes of Correspondence with all the important parts of Contract Law and Bill of Exchange which he comes face to face with in Correspondence daily. It would give him a sound knowledge about the stock exchange operations, insurance and import and export transactions. It would open to him all the secrets of Banking Business, give him a past data of the experiences of the Business World, give him a proper idea about the different countries of the World, their manufactures, products and industry. It would also make all the manipulations of Joint Stock Company work clear to him. Then we would not have to regret the deplorable indifference of our Company shareholders which has today moved the Government to take special measures to protect their interests because these shareholders are so

blind to them. It would then make it impossible to find capital for many so-called Public Companies formed by inexperienced men or men who simply wish to work same for their own benefits. Joint Stock Company enterprise is of course very essential to India but for the good of this enterprise, it is absolutely essential that it may not be made an instrument for making money by inscrupulous people. Do we not often see now-a-days prospectuses of some new Companies advertised with our morning papers and when we casually glance over the names of its proposed directors we often cannot prevent an ironical smile flickering across our features. The fact that such companies are so repeatedly advertised show that they do find people to invest money. This is to be regretted by all friends of Indian Joint Stock Company enterprise for, a general crash that is sure to follow would set us back in this department by years. If all our investors were more or less educated on business lines as they are now in Europe, the Companies with doubtful standing would find it very difficult to secure investors. In Europe, the position was the same some fifty years ago where many Bubble Companies brought the investing public to grief but to-day such events are very rare. Let us all hope that the years to come would place us in the same advantageous position and the day would soon come when all Indian Businessmen would have received in one form or other a specialised Commercial Education.

THE INDUSTRIAL POTENTIALITIES OF THE VIZAGAPATAM DISTRICT.

BY K. S. NARAIN RAO, ESQ.

*Managing Director, Industrial Development Co., Ltd.,
Anakapalle.*

Valuable papers on many industrial problems have been contributed by experts to the Industrial Conference year after year, and the country is deeply grateful to the writers and the indefatigable energy and patriotism of our esteemed countryman, the Honourable Rao Bahadur R. N. Mudholkar who has secured them. The earnest student of industrial problems and the capitalist will find in them a mass of useful information to work upon. If the country is to start any industries, it will be found that a particular place has the facilities for a particular industry. Bengal is the best place for jute mills, Bombay for cotton, the Western Ghats for timber, Malabar for copra, and Delhi for flour mills. But it is not every place that has the favourable conditions for a number of industries. Suppose a syndicate is formed to finance and work a variety of large and small industries. It cannot conveniently or possibly manage business scattered far over. I rejoice that such a syndicate has been formed by such illustrious noblemen as the Maharajahs of Durbhanga and Kasimbazar, and with a colossal programme of industrial work. Will not the Dharma Samavaya, Ltd., the syndicate being promoted by them, find it very convenient to select an area which can be turned into a centre of a number of industries, a field that can absorb millions and millions of capital? Now picture to yourselves a district with high plateaus, thousands of square miles of high plateaus, extensive rich forests, whose timbers can engage a number of saw mills, a soil on which everything thrives, fruit gardens, many minerals, fine rainfall, rivers, lakes and hills and cheap and abundant labour, and thousands and thousands of acres of

a variety of soil for extensive agricultural operations. Imagine a district which has in it all the facilities for the supply of the many wants and luxuries of man,—coffee, sugar, cups and saucers, paper and pencils, candles, cigars and matches, paddy, fruits, vegetables, flowers, honey, gunnies, precious stones, iron, timber, varnishes, oils, wax, lac and leather, all under one management, all going far out into the country. There is such a district, and that is the picturesque district of Vizagapatam I belong to it. Materials for all these and more are there, and they loudly call for enterprise to tap them. From my early boyhood I have dreamt of them. As I read in my school Geography about those numerous resources of my district, I was proud to belong to it. Later when I was old enough to understand that they wanted enormous money to turn them into articles of utility and beauty, I began to study the possibilities in my own humble way with the published and unpublished information that was available, and these ten years I have been occupied with that study. And thanking the Honourable Rao Bahadur Mudholkar for the opportunity he has been pleased to give me to lay before you what little I know, (as succinctly as time and place require) I proceed to my paper in the fervent hope that it will stimulate in you a desire to enquire and work.

The Vizagapatam District is the largest in India and the most populous in the province. The physical features of the district are varied and beautiful with high hills, plateaus, plains and rivers. The rain fall on the hills is splendid being an average of 57 inches in the year. The people are strong, hardy and prolific. There are many perennial rivers in the Jeypore territory, two of which contribute the whole of the water required for the second crop cultivation in the Godavery Delta. The Macheru is another important river which "flings itself over a sheer abyss of 480 feet into a boiling pool half-hidden by dense clouds of spray," and these are the highest falls in the Presidency. Again, there are the Sabari and Tel rivers which drain into the Godavery and the

Mahanady respectively. There are plateaus 8000 feet, 2000 feet and 1000 feet above sea level, and they are hundreds of square miles in extent. The highest joint reached by the ghats in the district is more than 5000 feet above sea level. In the plains, though there are no perennial rivers except the Nagavali, irrigation is carried on with the help of wells, tanks, the channels of the numerous streams and fair-weather rivers and two of the "very few real fresh water lakes in the Presidency"—the Candakarla Ava, a picturesque lake situated in an amphitheatre of hills near Anakapalle and the Komavarvolu Ava in the Golugonda Taluk. In the Anakapalle Taluk well-irrigation is carried on to remarkable extent though the means employed to lift water are not up to date. The climate is excellent generally both for human and plant life. Many of the economic plants of the Presidency are indigenous to the Jeypore hills. "There, may be met representatives of all the Indian plants a veritable botanical garden laid out for the study of the beginner." Speaking at the first Vizagapatam District Industrial Conference last June, of the soil and its adaptability to a variety of cultivation, Mr. D. L. Narayana Rao, a scientific agriculturist of about twenty years' practical and theoretical experience on his own extensive farms at Hyderabad (Deccan), said, "From an agriculturist's point of view, the deltaic lands of Godavery and Kistna are nothing compared with the lands in the Vizagapatam agency. In the deltaic taluks, the nature of the soils permits the cultivator to adopt a sort of destructive cultivation, whereas in the Jeypore hills the country is meant by nature for a variety of cultivation."

With such and so many natural facilities for prosperous and varied agricultural operations, I am anxious to lay before you a scheme of agricultural development dwelling on it at length to stimulate a desire to make the best of those gifts of nature. So many are the subjects I am tempted to dwell upon, of varying importance, that I do not know where to begin. The increasing attention paid to agriculture, however, leads

me to begin there. Here I take a useful paragraph from the prospectus of the proposed Hindu University of India.

“ Even where manufacturing industries have been largely developed, agriculture is bound to remain the greatest and most important national industry in India. Besides agriculture is the basic industry upon which most of the other industries depend. As the great scientist, Baron Leibig, has said, ‘perfect agriculture is the foundation of all trade and industry—is the foundation of the riches of the state.’ The prosperity of India is, therefore, inseparably bound up with the improvement of agriculture.”

If the western countries which are the wealthy countries that they are by their manufactures, are paying such great attention to scientific agriculture and applying themselves to agricultural industries, I think I am not wrong in dwelling at some length on those subjects as being the foremost in importance to our country where agriculture is the one chief industry.

Sugar, as engaging very serious attention in several quarters, may be taken first. It has raised a problem fraught with peculiar difficulties even where cane prospers most. Vizagapatam is a district long known for its sugarcane; and a solution of the problem should be such as to cover such a large cane field. The area under sugarcane in the district may be safely put down at 8000 acres producing about two lakhs of tons of cane at 25 tons per acre, Anakapalle Taluk and the neighbourhood alone contributing 75 per cent. of the crop. Is it not deplorable that there should not be one sugar factory where there is so much produce? Lately the Dekhan Sugar and Abkari Coy., Ltd., built a cane mill at Anakapalle, but after doing business for one season, have stopped it altogether. Now it is no good concealing from ourselves the difficulties that beset the manufacture. Right here I propose to look the problem in the face and suggest the lines on which a successful sugar factory can be established at or near Anakapalle. A French chemist said, “If I were given the climate of

India in France, I can produce enough sugar from sugarcanes to supply the whole world with it at rates cheaper than the present Market rates." And a failure of a sugar concern made in such a large cane centre as Anakapalle, demands a thorough investigation. The late Mr. Venkoba Rao in his interesting paper on the subject at the second session of this Conference rightly observed, "The foreigners who have thrown some capital in the sugar industry in the land, are not very well off and labour under very great disadvantage in making both ends meet, but they are *extremely reticent to disclose their difficulties*." I cannot make them speak, but I shall speak from what I have closely observed in the foreign company referred to above. I cannot be content with merely cataloguing the many productions of my district,—forest, agricultural and mineral—when the prospects of an important article of food seem to be imperilled by certain failures here and there. Two lakhs of tons of cane cannot be thrown out of account. I desire to be a bit outspoken. A sugar concern, to be successful, should have the confidence of the planter. The manufacturer should identify himself with the planter. "Raise and Rise" is a maxim which applies nowhere with greater force than here. To induce the planter to supply him with cane, the manufacturer should bear in mind that the planter may as well convert his cane into jaggery and sell it in the market he is conversant with, though it is the merchant-banker that rules it. To turn out a cart-load of jaggery by the primitive process, the planter requires eight times the cane and what can induce him to carry to the mill eight cart-loads of fresh cut cane expeditiously to oblige the Mill Company, necessitating to cover the road up and down sixteen times, when he could have as well converted the cane into jaggery and taken it to the market in one trip leisurely? This transit is no small item in his business. He exists for himself alone, and to make him exist for the manufacturer also, he should be paid well enough for his superfluous trips to see that selling canes is as profitable to him as selling jaggery. But the manufacturer naturally

grudges it. There is no common platform where the two interests can meet. This question is, to my mind, the very crux of the situation. The cane, to give its full yield, should be between the rollers within 24 hours after it is cut which is not possible, however, by bullock transport. Then, again, there is another fact worth considering. The enormous output of cane does not come from one compact holding. It comes from thousands of small holdings scattered far over the area. Therefore, it is absolutely necessary that the manufacturer should keep his own motor-vans to transport the cane from the garden to the mill, rather than pay the costly bullock.

In this connection it is a matter of supreme importance to bear in mind that it costs the ryot next to nothing to convert his cane into jaggery. He does it on the time-honoured village co-operative system. The ryot can afford to do the crushing himself with neighbourly labour having the leisure for it. Taking him then as he is, the manufacturer should see his way to arrange his own rapid transport. I know that this was not done by the Anakapalle mill. The manufacturer in his own interests and in those of the planter without whom he cannot do, should rescue him from the grip of the *sowcar*. The agricultural advances made to the planter, would make the manufacturer none the worse for it. On the contrary, the manufacturer can have a hold on the planter *without ruining him*. He has a fair rate of interest on the amount advanced in addition to an assured cane supply. The manufacturer should also engage an agricultural Inspector to be going round among the planters to give them the necessary advice, to supply him with superior seed and modern implements and to report to the mill on the crops on the primary security of which the advances were made. Men do not become useful *ex-officio*. Trained agricultural intellect is not very costly in India. A salary of five or six hundred rupees a month does not necessarily make the manager an expert adviser. Here I must observe that a sugar manufacturer that requires a

dubash to do his business with the planters, is terribly handicapped. The company that pays a decent commission to its local purchasing agent, another to its own highly paid general agent, and yet a third to its managing agents, all on the same purchase, has no right to complain of bad failures. When I speak of this state of things, I do not exaggerate. I know an Indian company at Anakapalle has been purchasing every year more than a million rupees worth of jaggery through a clerk getting 25 Rs. a month. Where then is the need of a management costing many thousands of rupees a year, all to buy a smaller quantity of jaggery than the clerk on Rs. 25 does? Yet an English company doing this business with the Indian planter, cannot possibly have that constant intelligent touch with thousands of planters of whom it knows nothing, which an ordinary Indian with the necessary business shrewdness can have. A capitalist with credit in some Bank or the ready money of a firm, just down among the ryots with his plants and estimates ready finds himself at considerable disadvantage in this industry. I may also add that the Anakapalle cane mill only made the treacle which was railed off to Samalkot at considerable expense and there converted into sugar at the company's sugar factory. Anakapalle and its neighbourhood contain lakhs of palmyra palms which may be tapped for sweet toddy to be made into jaggery, and that is very good material to be refined into sugar during the off-season. Sweet toddy, you know, is free from excise duty. An Americo-Indian sugar trust is talked off in the papers, and if that comes to pass, India should be content with supplying coolies and clerks and nothing else. Before American enterprise may step in, why not Indian capitalists unite to invade the cane centres and have their own sugar factories? Here I give a scheme for a modest beginning in the Vizagapatam District. A model factory, to turn out 6 tons of sugar per day of 24 hours from cane direct during the season and from cane and palm jaggery during the off-

season without animal charcoal, would not require more than a couple of lakhs of rupees, as detailed below:—

				Rs.
Machinery on spot	...	...	...	60,000
Erecting buildings and machinery			...	20,000
Working capital	...	...	...	20,000
Motor vans	...	...	...	20,000
200 acre cane plantation	...	...	...	20,000
For agricultural banking	...	...	...	50,000
			<u>Total</u>	<u>200,000</u>

The figures for the first three items are Mr. Jordon's, to which I add the other three.

A two hundred acre plantation gives us at twenty-five tons an acre 5,000 tons of cane which is the quantity required by our mill during the cane season of 100 days. The mill can be expected to pay about 20 per cent. on the outlay. It must be borne in mind that this is only a model factory and not one capable of dealing with the entire crop of the District. The mention of cane plantations brings me to the very important question of agricultural settlements in the district. This is about the most important part of my paper.

Throughout the District, both in the plains and in the agency, there are available thousands of acres of fertile virgin land suited, as I have already said, to a variety of cultivation. Round about Anakapalle many acres of both Government and Zemindari lands can be secured in plots of not less than 50 acres at a place. What cannot be grown there? The soil of the Sarada valley is red ferruginous and is very fertile. Garden culture can be carried on extensively and gardening here pays exceedingly well—and where does it not? The two principal gardens of the district, Anakapalle and Alamanda, are exporting fruits and vegetables to various places in the Northern Circars, the Nizam's dominions, Calcutta and even the far off United Provinces, oranges, limes, sapodillas, litchees, mangoes, plantains, guavas, cocoanuts, pine-apples, peaches and jacks thrive well both on the

plains and the hills. Careful calculations show that fruit and vegetable gardens in this district pay cent. per cent. on the outlay. "Vegetables are now dearer than rice weight for weight." Then there are the economic crops like coffee, tea, sugarcane, jute, ginger, turmeric, cocoa, and superior cotton that can be grown in the tracts referred to. The Maharajah of Vizianagram has a successful coffee garden on the Anantagiri hills. These loose-jacket variety of the Vizagapatam orange must command the market in any city owing to its size and deliciousness. If along with the gardens fruit preserving and canning factories are established under expert management, not only can the fruit be sent to distant markets at a large profit but the import of large quantities of tinned fruit from abroad can be prevented. The lime gives citric acid and lemon oil, and the half-dead peel may be made into a pickle for home and foreign use. Marmalade is made from orange, and jams and jellies from other fruits. Simhachalam is well known for its pine-apple. Every part of the pine-apple can be turned into account. "The pine-apple or ananas grows anywhere with a little care. It can be put up as hedges. A pleasant wine is made from the fruit. The fibre is nearly white, very soft, silky and pliant and at the same time strong, durable and susceptible of fine sub-division. It is as long in staple as flax and can be treated by the same machinery. It is proof against immersion in water. It forms the most delicate fabrics as well as fishing lines and ropes." Bissamkatak produces "wonderful" tobacco which is in great demand in the Central Provinces, purchasers going from Raipur and Sambalpur to Bissamkatak for the article. Successful experiments have been made with rubber plantation in Parvatipore and an attempt may be made on a commercial scale in the valleys and the plateaus of the agency tracts. Cambodia cotton which was found to be a good annual of fine staple, can be raised on many of the gardens and high level wet-lands with a thorough drainage. The Spence cotton which was pronounced to be a complete success by

Mr. Spence after trials in his Wellao larui, is a hardy perennial and is reputed to yield a crop for 25 years. The seeds planted by way of curiosity in the backyards of some of my friends' houses at Anakapalle, have been giving very good results. The fact that the Government found in a plot of 45 acres at Anakapalle soils for garden, sugarcane, cotton and paddy, is a strong support to my statement about the fertility and variety of the soils of the Sarada valley. Labour difficulties need not keep back the intending capitalists from launching on large agricultural operations in the Vizagapatam agency. When the planters of Assam, the Federated Malay States, Fiji and Trinidad are able to get coolies for their plantations, I do not despair of recruiting labour for any extensive agricultural operations, if only a systematic labour supply arrangement is made. It may interest you to learn that large numbers of coolies are going from this district alone to the far off countries just mentioned, and they would hail with joy any enterprise that would provide them with the means of livelihood nearer home. Before going to the forest products of the district, I should like to say a few words about jute and its possibilities. In the Palakonda, Chipurupalle, Bobbili, Gajapatinagaram, Anakapalle and Sawasiddhi Taluks of the district about 50,000 acres are under jute. The fair prices now secured for it, are inducing the ryot to extend the area under it. There is only one jute mill in the district and it cannot use the entire crop. The district is also supplying the jute mill at Ellore in the Kistna District and yet has a large quantity for export. There is room for at least one more jute mill. The quality of the jute in the Anakapalle Taluk is so high that a gentleman-farmer of Kasimkote three miles from Anakapalle got a gold medal for it at the last Calcutta Exhibition, and the late Mr. N. G. Mukherjea, who supplied him with the seed, was surprised to see such splendid results. The establishment of another mill, the import of the Bengal seed and the teaching of better methods of fibre extraction would give a very great stimulus to the industry. The gunnies made from the Vizagapatam jute, I may

mention *en passant*, command higher prices than the Calcutta gunnies. The mill need not seek any market outside the districts of Ganjam, Vizagapatam and Godavery. The jaggery trade of my district requires at the rate of 18 gunnies for a ton of jaggery more than three lakhs of gunnies a year. Then there are the oil seed and forest produce trades. Whether they are used locally or sent out of the country, the all-covering gunny must be there to transport them from the farm to the market. Messrs. Ralli and other firms who purchase the oil-seeds on an extensive scale, are now getting the Calcutta gunny. Here, therefore, we have the raw material of a good quality, cheap and abundant labour, a railway service to transport the fibre to the mill centre and a market at your own doors whose demands you cannot hope to supply. A mill may, therefore, be started at Gajapathinagaram or Anakapalle, better the latter place as, you will find from its many potentialities, it has the making of an industrial centre. I have only to add that the Bimlipatam jute mill was regarded as "the milch cow" of the late Arbuthnot's.

There is an unlimited supply of oil-seeds in the agency and the plains. This is now exported to the foreign countries to the value of a million rupees a year. The export, of oil-seed, instead of the oil, is sending away the life-blood of the soil for, as you know, oil cake is one of the best manures. Oil mills and allied industries may be started at Anakapalle, Parvatipore and Kalyanasingapore Road to crush gingelly, niger, mustard, rape, castor and Mahua seed. Kalyanasingapore Road will be the nearest Railway station on the Vizianagaram Raipore Railway now under construction, to Bissamkatak which produces large quantities of a variety of oil-seed. The estate is rich in many other forest, agricultural and mineral products, and they are referred to in their proper places. Groundnut too, thrives well in the district, and its cultivation is on the increase.

I shall now refer to the many possibilities for converting the forests of the district, now the haunts of wild beasts and malaria, into smiling bee hives of industrial activity. The

smoke from the forest fires will then give place to the smoke of the factory chimney and the hearths of cottages of thousands of contented and happy settlers, and the roar and howl of the wild beast to the whistle of the factory. These forests, it may be noted, are co-terminus with the Central Provinces. Large quantities of lac are produced in the forests of the district. It is well known, that the insect deposits the resinous dye on the branches of sal (*shorea robusta*), palas (*bhrutea frondosa*), Kusum (*schluchara trijuga*) and babool (*acacia arabica*), and as the Vizagapatam forests are thickly wooded with these trees, the production of lac is so large that the area goes by the name of *lakkamalias* or lac forests. The lac is used for a variety of purposes. Sealing wax, varnish and the lac dye are made of it, and it is largely used in manufacturing gramophone records, lithographic inks, electrical appliances and in stiffening hats. Mahua oil contains much vegetable fat and can be used for manufacturing candles. From the flower, industrial alcohol can be distilled. The cheap alcohol and lac should enable us to produce sealing wax and varnish at competing prices. The tanning and dyeing materials are either exported or left idle in the forests. The valuable dye-stuffs,—safflower, turmeric and myrobalans and the marking nut can be had in any quantity. Lac-dye is already referred to. Myrobalans of the value of 2·5 lacs of rupees are sent out of the district every year. In the Gologonda Taluk there is a regular forest of myrobalans called "Karak reserve." In addition to being a dye-stuff myrobalan is largely used in tanning and ink manufacture. For tanning there is the *tangedu* bark also. Expensive areas suitable for growing *divi-divi* another tanning material are available. Horns, honey, wax, tamarind and arrow-root are next in importance as forest products. Excellent paper stock is abundant. Bamboos of fine quality, *bhabhar* and *munj*, grasses can be had in any quantity, and pulp mills can be started in any of the forests to supply the paper factories to be started at or near a railway station. Prof. Sindall says that bamboo is very good material for paper manufacture. I

remember that the Vizagapatam Forest Department some years ago offered to supply the Bengal Paper mills with the grasses, but they could not accept the offer owing to the heavy transport charges to Calcutta. In addition to the materials which the forests supply us, we have plantain, jute and hemp cuttings and old gunny bags to augment the supply. In his paper on match woods contributed to the second session of this Conference, Rai Saheb Upendranath Kanjilal has given a list of woods suitable for match manufacture, and the following varieties out of that are available in the forests of the Vizagapatam District:—1. *Ailanthus Excelsa* (mahanim), 2. *Boswellia serrata* (Sala), 3 *Gyrocarpus Jacquini* (*Pitella*), 4 *Bombax Malabaricum* (*Simal*) and 5. The thick-walled straight bamboo called *Bamboosa Balcoa*. All these are said to be remarkable fast-growers and can be propagated easily. The Imperial Forest Department has investigated the question and after many experiments, selected Konda Santha, Kistadeopet, Narasapatam and Palakonda as suitable places in the Vizagapatam District for the establishment of match factories. Evidently the enquiry was confined to the Government forests in the district. I know that the varieties are found in the Zemindary forests also. Successful match factories could, therefore, be opened at Bayyavaram, Anakapalle, Gummulur, and Amidalavalasa (Chicacole Road), the nearest railway stations to the forests mentioned by Government. Again, match factories can be started at some of the stations on the Vijianagram-Raipur Railway to utilise the woods in the very extensive Jeypore and Parvatipore agencies. A modest beginning can be made, for Messrs. Jessop and Appleby Bros. say they can supply the machinery and an iron shed for Rs. 15,000. In Japan which sends the largest percentage of matches imported into India, it is almost a home industry. Many varieties of white wood suitable for pencil manufacture, are also available in the forests. A few words about the many splendid building timbers, and I shall close my account of the forest wealth of the district. There is *shorea robusta* (sal) from which "the most indestructible railway sleepers are made." You

have large forests of sal in the Jeypore, Bissamkatak and Kurupam Zemindaries. Egisa is another timber largely used for building and furniture purposes. It is largely used for the hubs and spokes of carriage wheels. Nallamaddi (*terminalia tomentosa*) is another splendid building timber. It is noted for its strength. There are large quantities of rose black and satin woods. Thangedu is another fine wood for beams. Owing to lack of enterprise, these woods are not known far out of the Telugu districts. The establishment of saw mills at Parvatipore, Kalyanasingapore Road and Anakapalle, the nearest railway stations to the timber forests under reference, would be a very profitable investment. The Railway Board are importing Karri and Jarra for Railway sleepers in large quantities from Australia. I am, therefore, confident that with such hard woods, cheap and abundant labour and an assured home market, Indian saw mills established at or near the forest areas under reference, would be a commercial success. Teak is found in Malakanagiri and some parts of Naurangapur. Though a minor article compared with the above, I know personally that rattan is found in Bissamkatak. In this connection I may mention that cheap electric power to work the saw mills, to run the forest tramways and such industrial concerns as may be started in their neighbourhood, —pulp mills, splint mills and fruit factories, can be generated in two places in the district. The water of the large lake on the Nimgiris in Bissamkatak may be led through conduits to a precipice and there converted into a fall to generate electricity and after doing its work irrigate thousands of acres in the valley below. The Macheru Falls referred to in the general description of the district, may be harnessed for a similar purpose on the southern side of the district. There are thus two great water forces, as though nature has designed the two reservoirs of latent energy to one day become patent and be the source of new life and wealth to the people of the country. One set of industrial enterprises at or near Anakapalle could be run by the Macheru Power station, the

northern or Kalyanasingapore set by the Nimgri Scheme. Get your Wonderful Lamp, and what will not those giants do for the district? There are also in the forests of the district such medicinal drugs as nuxvomica, senna, sarsaparilla, chirelta and long pepper and an endless variety of hard seeds that can be turned into fine buttons. The trade in hides and skins is very large, and there are about a dozen tanneries in Jeypore and Vizianagram, all in the hands of Mahomedans who bark—tan them by the old process and export them. A large tannery and leather works on modern lines, if established at Vizianagram, would be a very paying concern.

The manganese mines of the district are well-known throughout the world. It is only the recent general depression in the trade that has prevented further extension of the operations. But the manganese mining industry of the district is in the hands of two European companies, one with sterling and the other with rupee capital. I for one do not grudge foreign enterprise stepping in. But for its appearance in the district, I could never hope that the existence of the mineral there, would have been known to any in the district. I look upon the mines as an object lesson to us,—the much-needed object lesson. There are many deposits in the district which have not yet felt the miner's pick or the prospector's drill. "The same rock as that which is yielding manganese in the Central Provinces, may be continued south to Vizianagram and the intervening space may yield manganese." The intervening space is the agency referred to above. It is found in Bissamkatak, in Andra and Parvatipore Hills. Iron ore is abundant in the Jeypore Hills and a "lode was found in the rocks of the Kurnool series at Chitra near Kotapad." It is also found around Narayanapatnam. Plumbago is found in the Causipore valley, Bissamkatak, Tonam, Mamidipalem, Merangi and Koppaka Hills. It was the presence of plumbago and the pencil woods referred to in another place that induced me to start a pencil factory at Anaka-

palle, which has all the elements of success except working capital. Mica is found near Kodur and Bissamkatak. "Gold is known to exist in the district. Its presence is asserted but it is not yet proved." Antimony which some think, is, Galena, is observed at Kodur. Garnets are found near Galikonda, and many of the metamorphic rocks of the Eastern Ghats. The hydrated alumine beyond Koraput may be used as an ore for a luminium. Wolfram sands are observed on the Waltair shore. "Sapherine which has been found only at Fiskernass in Greenland, was discovered one mile and a half south-west of Paderu. In the bridle path to Ganagarasu Madogole." Kaolin can be had near Vizianagram and near the other manganese deposits. An unrefined form of it is used for making goggles at Vizianagram. A porcelain factory may, therefore, be established at that place. For paints there are gem or red oxide yellow ochre and plumbago. There are, therefore, very strong grounds for a systematic survey of the mineral possibilities of the district before arrangements are made for exploitation on commerical lines. The Jeypore territory is the granary of the district during times of scarcity, and better and more rapid means of transport and communications would enable the regular export of paddy to other parts of the country throughout the year. The straw in some of the fields of the country is burnt away for a clearing. The immense quantities of straw thus wasted could be used in the manufacture of straw-boards. The demand for boards is very large, as it is largely used by cotton spinning mills, Box companies, Soap companies and Cotton ginning companies for their rollers. A number of rice mills can be started in the Jeypore and Naurangapur territories, and the rice exported, as the freight or transport charges on rice would be cheaper than on paddy.

If along with the arrangements for agricultural settlements and forest exploitation, light railways are taken on hand to connect the Jeypore plateaus with the plains, the country is bound to give a very happy account of itself

from every point of view at the next census. Naurangapur and Upper Jeypore form an extensive plateau extending right up to the Central Provinces. I propose a line of railway from Jeypore to Raipur *via* Naurangapur and Pappadahandy and another from Naurangapur to Kalyansingapore Road on the Vizianagram-Raipur system. Another light railway full of promise and one that is necessary for our scheme of general development of the resources of the district is one from Anakapalle to Madogole along the first class Local Fund road now connecting the two places. The line, being only 22 miles, may occupy the first place in our railway programme. Madogole is at the foot of the ghats and the forests that go straight to the Central Provinces. Malakangiri may be joined to Jeypore *via* Jarapalli, Udayagiri and Ramagiri so that in course of time the various plateaus of the Jeypore State may be connected with one another and with the outside world on the plains. Another important line that suggests itself to the careful student of the geography and economic possibilities of the Vizagapatam agency is one that would tap the fertile and rich valleys of the Bissamkatak Estate. The line may start from a joint near Ambadola, a probable station on the Vizianagram-Raipur system and passing Jagadalpore run down the Vamsadhara valley *via* Gudair to Gunupur. The territory around Ambadola and Jagadalpore, and the Vamsadhara valley are very fertile and capable of immense development. And the Gunupur Taluk is already famous for its agricultural products, "Gunupur rice being favourably known as far ahead as Calcutta." I learn that it is under consideration to continue the Parlakimidy Light Railway up to Gunupur and thence *via* Lakshmiipuram and Gunuma to Parvatipore. If that extension be taken on hand, well and good. If not, the line from Ambadola may be continued beyond Gunupur to Parvatipore forming an important junction with the Vizianagram-Raipur Railway Section of the Bengal-Nagpur system and providing a direct

means of communication with the sea-board at Vizagapatam. Mr. Thomas, sometime District and Sessions Judge of Vizagapatam, must have had this network of Railways in view, when we prophesied that Vizagapatam is the natural port of the Central Provinces. Yes, it is destined to be that, when the Raipur line is pushed on beyond its present terminus at Parvatipore and the lines proposed by me are an accomplished fact. The entire wealth of the agency,—forest, agricultural and mineral, will flow down to the sea-board in many train loads a day through the junction at Parvatipore. This Railway development, coupled with the conversion of Vizagapatam into "more than a mercantile harbour" which, as the *Madras Mail* said, "Government must have in mind in view of the extensive preliminary operations now carried on," would lead to results the economic value of which cannot be overestimated. The rails and other accessories from your own great Tata works, the sleepers from your own forests and saw mills, the labour your own, objects your own, let the capital too be your own. What a grand day, if it could be! When that happy day comes, which may be in the life time of this generation, Anakapalle, the "sorrowless village," as its name implies, will have better claims to become not only the southern industrial centre of the district, but also the suburban residence of the surplus population of Vizagapatam which with its importance as a first class port and the limited space at its disposal for expansion all round cannot hope to accommodate on advantageous terms. Many gentlemen in the district propose to have country houses at Anakapalle, and to be prepared for future demands, the Local Municipal Board has large town extension schemes on hand. Both Vizagapatam and Anakapalle will then become very good fields for real property and housing enterprise.

I have shown you in the course of this paper the immense potentialities of the district for industrial, agricultural and mining enterprises. I have shown you that there are many square miles of new country to be occupied by an industrious

population now labouring beyond the seas for the prosperity of other countries. I have shown you that the district has the materials for the establishment of successful sugar, jute, paper, pencil, match and candle factories. I have laid before you a scheme for the opening of a number of chemical industries. I have proved by facts my statement at the beginning of this paper, that the district has the potentialities to supply many of the necessaries and luxuries of man.

Will there be no earnest attempts made to develop such a district? Or will you allow others to take time by the forelock and step in to take what may be your own, what should be your own? His Highness the enlightened and patriotic Maharajah of Mysore in his presidential address at the Economic Conference held in Mysore last June, said, "We do not want mere ornamental members." What could have prompted His Highness to say that? The question answers itself. The results of that Conference launched under such patronage, we shall watch with great interest. I am not a pessimist: even in the midst of my disappointments I am not. A match factory in Calcutta, another at Bombay, the colossal Tata Iron and Steel works there, the gigantic Hydro-electric Project at Bombay, the soap factories in many places, the expansion of the cotton mill industry, the Banga Lakshmi cotton mills in Calcutta, the jute mills of Ellore, these and many more are the signs of the times. The Industrial Exhibitions, district, provincial and Indian, organised at enormous cost of labour and money are a force that should bear fruit in fulness of time. The ever-memorable Inaugural address of His illustrious Highness the Maharajah of Gaekwar at the last Industrial Conference held here, has a significance all its own.

Yet it may be that we are not altogether wide-awake. To my mind, we are in the position of a man who is awakened from sleep to do an urgent thing and has not quite done the rubbing of his eyes. Great as is the work that lies before us, we should not forget that what has been done, has been done in the short time we have risen from our long sleep, in the yawning interim. Some failures are inevitable in such a period

of what may be called semi-wakefulness. But, desponding, we can do nothing. The failures of such a period should teach us only caution and not despair and indifference. Where formerly little information could be had or no thirst for it was in evidence, there is now so much at your elbow. Look at the bulk of valuable industrial literature turned in the office of our worthy, veteran soldier of the cause, the Honourable Rao Bahadur Mudholkar. It is sinking even into school boys. The speaker at a Conference put in charge of a resolution, finds now a number of reference books. An industrial apostle, in his zeal, may wish the progress had been speedier, but progress there certainly is.

You have an urgent duty to those devoted workers who are bursting their lungs crying for help from the weather-tossed ship. I urge upon my countrymen the need of hastening to their rescue, that they may work better with the lives you have saved and the nourishment you have given, that their unheeded cries may not deter other willing workers from entering into this service of the country. It rests with you to find out such men and secure that and avert this. Each such man saved, will be a tower of strength to the cause. Each languishing, honest industry you have put on its legs, will be a mile-stone in the progress you have inaugurated. That I consider the first duty of the country at this moment. The wounded picked up from the field and healed of their wounds, will fight again. They must be found out by search-lights. O let them not die unheeded on the field; let them die, if die they should, in the hospital; for the dust of one unmerited death, of one unheeded death may heap mountains on the cause, on the particular industry the man had toiled for, had suffered for, and—died for !!

I have laid before you the more important of my material, the results of my labours of ten years. I have left out many smaller matters to keep my paper within the limits of a Conference contribution. I shall feel it a high reward for my humble labours, if my paper leads to an enquiry, a higher reward if it results in the working out of

but one of the many items I have placed before you, and its success my highest reward. I do not pretend to be able to give details for all the items, say the hydro-electric and railway schemes. I have taken all the pains I could, to verify the results of my labours with the facts in publications of unquestionable authenticity. With regard to my district, all that I can say, is "There is the marble". The chisel to work it, *you* must find. The political India is put in provinces, but there should be but *one* undivided Industrial India. The cataracts and hills and valleys and plains and forests of my district are as much yours as they are ours over there. They belong to the district of patriotism and enterprise. Let not the cataracts in the district continue to leap down their giddy heights without giving you the mighty power they have. How long is the earth there to hide its mineral wealth? Let not the master keep such wealth too long in servant's custody. Is the fertile virgin soil of the vast stretches of plateau and plain to remain a confirmed old maid?

I have told my story and fervently hope that, before the next Conference comes round, there will have been made appreciable efforts to plan a scheme of work to develop the teeming resources of the largest district in India.

INDIAN BUILDERS AND PUBLIC WORKS ARCHITECTURE.

BY E. B. HAVELL, ESQ.

The late Principal of the School of Art, Calcutta.

When we get down to fundamentals in the economic life of every country, the vital national industries with which we shall have to deal will resolve themselves into three groups, *viz*: those relating to (1) Food; (2) Clothing; (3) Shelter. Thus the three main industries, or groups of industry, to which every other is more or less subsidiary,

and on which national prosperity is wholly dependant, are Agriculture, Weaving, and the Building industry.

It is with the last of these three great industrial groups that I propose to deal in this paper. The important place which the building industry holds in the economic state of every civilised country has not yet been sufficiently realised in India. In spite of all the discussions on industrial questions which have taken place in recent years, I do not know of any official document which throws light on the subject, and I believe that this is the first time that it has been brought before the Industrial Conference. Yet the building industry embraces nearly all the most important handicrafts of India, and, as in every country, its condition is an index of economic progress and of every kind of artistic development ; for not only does it fulfil manifold purposes of practical utility, but in its full development it brings into play man's highest creative faculties. Architecture has been justly called the noblest of all the arts : the history of every civilised state is written in it, and in its objective reality it contains a record of national culture and material progress which is generally much more reliable than that given by pen or printer's type.

The importance of the building industry in the economic life of Western nations can be gauged from the fact that in the United Kingdom the gross output of the building and contracting trades for the year 1907 was of the value of £87,967,000 sterling ; the net output £42,954,000 sterling ; and the number of persons employed in them 513,961. It is rather characteristic of Swadeshi industrial activities in India that while considerable attention has been devoted to such minor problems as the production of Swadeshi ink, nibs and pencils, the enormous indigenous building industry of India has not yet been placed on the Swadeshi programme.

It would be quite impossible to cover the whole ground of such a large subject, or to enter into many technical details in this paper. I must confine myself to some of the general aspects of the question, and to the attempt to clear up the confusion which has been brought into it by some recent authoritative pronouncements. As in every other subject connected with Indian economics, one is confronted at the outset with the difficulty created by the almost entire absence of reliable statistics and information to enable one to diagnose the actual condition of this great branch of industry in India. I venture to suggest that if the Indian Industrial Conference would organise a statistical *bureau* to co-operate with official efforts in the collection of exact information on this most important subject, it would do India a very valuable public service.

For administrative purposes the importance of accurate statistics can hardly be exaggerated. In public policy they represent all that true premises stand for in logic. Wrong statistics are just as detrimental to good administration as false premises are fatal to sound logic. It is equally important that the analysis of statistics relating to industry should not be considered a matter of general departmental routine, but be dealt with by experts with competent technical knowledge who are fully informed as to indigenous condition, affecting the industry concerned, otherwise the inferences drawn from accurate statistics may be entirely wrong.

A striking illustration of this was furnished by the statistics relating to Indian trade and industry which, before the formation of a Department of Industry and Commerce, were presented to the public and quoted in the special article on India in the 10th Edition of the *Encyclopædia Britannica*. The Indian Census returns clearly

indicate the paramount importance of the weaving handicraft in the Indian industrial system by revealing the simple fact that it gives employment to over five millions of the population, a number exceeding the aggregate employed in all other industries except agriculture. But the departmental officer, who prepared the analysis of these figures for public information, no doubt inspired by the common but ignorant belief that mechanical inventions have made handicraft a factor of no importance in modern commercial progress, quietly wiped out the five million hand-weavers with a stroke of his pen, and presented the public with the information that India's greatest industry, after agriculture, was the work carried on by the powerloom mills which gave employment to about 350,000 hands!

Statistics of this kind, issued with all the prestige of Government authority, and presumably summing up all official knowledge of the subject, have a very harmful influence. They mislead public opinion and give a wrong direction to educational efforts. Up to about ten years ago, when I ventured to point out the error of these statistics, which I am glad to notice has been corrected in the new Edition of the Encyclopædia, hand-weaving was an industry which had been completely ignored in all official and non-official schemes for industrial improvement in India. This is no longer the case. A great deal of light has been thrown on the subject since, and much practical work has been done which cannot fail to have a powerful influence for good on India's industrial and social development. But nothing so far has been effected in India officially to compare with the revival of hand-weaving brought about in Ireland by the efforts of the Department of Agriculture, or with similar successful efforts in other European countries. Even now the view which seems to find most favour with Swadeshi reformers

and official experts is to regard the existence of this greatest of Indian handicrafts as an indication of India's economic backwardness rather than as a factor of the most vital importance, containing as it does the means by which India in her future industrial development may preserve a far safer economic equilibrium than obtains in modern Europe, and thus avoid those grave social disorders which afflict the great mass of the industrial population of Europe. It is in this short-sighted view of her larger national interests, held by many leaders of public opinion—in their failure to realise the higher purpose towards which scientific progress in Europe is inevitably tending—and not in the relatively small number of her mills and factories, that India is less progressive than the more advanced thought of Western industrialism. Skill of hand is a part of human mentality for which mechanical inventions are auxiliary, but not substitutes and the nations which neglect that part of intellectual and physical culture are bound sooner or later to fall behind in the march of human progress.

The same kind of mental confusion obscures the real issues in the question of Indian architecture. Reliable statistics of the present condition of the Indian building industry there are none : Public opinion on the subject is wholly uninformed, and, just as the case with the weaving industry until a few years ago, public policy guided by long departmental tradition ignores its very existence and only seeks for improvements which can easily be imported direct from Europe. I do not suggest that any of the officers of Government are to blame for this state of things : it is simply that the official machinery is at present totally inadequate for dealing with all the questions relating to art and industry. And until the proper expert machinery is provided and official

measures are based upon clear knowledge of indigenous conditions and complete comprehension of technical requirements it is vain to look to the already overburdened Secretariats for light and leading on this subject, or for a continuous and well-defined public policy based upon sound principles. A story is told of an officer of the Royal Engineers, who was head of the Survey of India before it was constituted as a separate department of Government, complaining that as soon as he had proved to one Secretary to Government that an equilateral triangle had three equal angles a new Secretary would come to whom the proposition had to be explained again. The same kind of difficulty has to be faced by every art and industrial expert, who is placed in an official position either in India or in England.

It is, however, just as well, seeing how different the conditions are to those which exist in Europe, that experts who are sent out by the Secretary of State for India should not be given too loose a rein until they themselves fully understand the new problems with which they have to deal, and until they have helped the Secretariats which control them to formulate sound principles which will ensure continuity of policy and prevent departmental friction. For if Secretariats are sometimes a stumbling block to experts, it is just as often that experts mislead Secretariats, and this is especially the case in a subject which is so little understood by European experts as Indian art.

The first thing essential to progress in all matters relating to Indian art is, therefore, a full investigation of the special conditions which obtain in India. I will begin by briefly examining the historical data relative to Indian architecture. All authorities agree that in times gone by Indian builders has done great things. Even

those who depreciate Indian sculpture, painting and music will generally admit the genius of the Indian architect. But it is a part of those erroneous and prejudiced views of Indian art, which are so commonly held both by Anglo-Indians and educated Indians, to give most of the credit for the triumphs of Indian Master-builders to the Moguls. Centuries before the Moguls came to India, Hindustan was famous for her Master-builders, and if Europeans can only see in Mogul buildings the greatest works of the Indian architect it is only because Muhammadan or Saracenic architectural ideals approximate more closely to the architectural forms of the Italian Renaissance than does the religious architecture of the Hindus. It was to the broad-mindedness of Akbar in attracting to his Court all the skilled Master-builders of Hindustan that the greatness of Mogul architecture was due. The Mogul buildings themselves give the clearest proof of this, for the finest of them are better works of art than any that the Muhammadans built in any other country, and they all contain some constructional principle or architectural feature which essentially belongs to Hindu art. In their raids upon India before the time of Babar it was the common practice of the Muhammadan invaders to take back Indian artisans to help in the building of their mosques. One of the most reliable of Mahammadan historians, Alberuni, who visited India in the eleventh century, was amazed at the skill of Hindu builders, especially in the construction of bathing tanks. "In this," he says, "they have attained to a very high degree of art, so that our people (the Muslims) when they see them wonder at them and are unable to describe them, much less to construct anything like them." Although the Moguls brought into Indian architecture notions of greater spaciousness and decorative simplicity,

to which the Hindu builders readily adapted themselves, the new development of it under Mogul rule came not from the teaching of Muhammadan builders but because they directed the skill of Hindu builders into new channels. Mogul architecture is properly described not as specially Muhammadan but as Indian.

Coming down to modern times we find the great historian of Indian architecture, Fergusson, referring to the India of his time as holding up an example to Europe. "Architecture," he wrote, "was in India a still living art, practised on the principles which caused its wonderful development in Europe in the 12th and 13th centuries; and there consequently, and there alone, the student of architecture has chance of seeing the real principles of the art in action." He declared that if only Indians could be made to take a pride in their own art, Indian builders were quite capable of equalling or surpassing the great works of their forefathers. More recent writers like Mr. J.L. Kipling in the *Journal of Indian Art and Industry* have given evidence to the same effect, and I myself can corroborate their testimony from many years' observation in different parts of India, especially in the North.

I believe Fergusson's statement on the whole to be as true now as when it was written. I was, therefore, very much astonished to see that in a paper read before the East India Association in London recently, Mr. J. Begg, the Consulting Architect to the Government of India, "totally ignores the existence of Indian Architects, complains of the "absence of any reliable source for the supply of capable assistants" in his work, and speaks of the Indian workman as being "a complete master of one art only, that of scamping." "The arts of India," he added, "are dead, or nearly so, and her crafts are little better."

It, in the course of forty or fifty years since Ferguson wrote, there has been such a deplorable deterioration in one of the most vital of Indian crafts, a full investigation of the causes which have led to it, is imperatively needed. During all this time the Public Works Department has maintained a monopoly of the most important building operations in British India. As Mr. Begg himself states, "official design and building work still bear a ratio to the aggregate of work in the country in enormous excess of what it does, say in England." The responsibility of the Department in this matter, is therefore, very great, and if its methods or principles, in the course of half a century, have led to the practical annihilation of all the splendid traditions of Indian building the remedy which Mr. Begg proposes, *viz.*, the importation of more professional architects from England, clearly does not meet the case.

I will not attempt to discuss whether Mr. Begg's apology for Public Works architecture—that "it has not been contemptible, but distinctly above the average of amateur work"—should be considered satisfactory from an administrative point of view. I should have thought that the public service should have dispensed with highly paid officials whose work was only amateurish and not contemptible. But the issues to be settled are much more important than this. If the Public Works administration has been so ill-adapted to the needs of India as to produce the conditions described by the Consulting Architect there must be something seriously and radically wrong in its methods, and it will make very little difference in administrative efficiency whether the same system is carried on by "professionals" or by "amateurs."

But in examining Mr. Begg's statements more closely I think we shall find that the situation is not quite so bad

as he represents it to be. He admits that he has had less than ordinary opportunities for studying the conditions which prevail outside the scope of his own special duties. It would have been more judicious, therefore, if, before he made statements of this kind with all the authority of his official position, he had tried to enlarge the range of his experience so as to come into touch with the many thousands of Indian master-builders and other craftsmen who still carry on the best traditions of Indian art, and who remain outside the range of his Department's operations not because they lack skill or intelligence, but because it refuses to adapt its methods to the conditions under which India in the past has, as Mr. Begg admits, produced some of the finest architecture in the world. The Indian master-builder is an architect with as much pride in his profession as Mr. Begg himself : he may be illiterate, but Fergusson, who devoted forty years to the intimate study of Indian architecture, confessed that he had learnt more from him than from all the books he had read. Like any other artist, he objects to work under conditions which deprive him of all initiative and opportunity for artistic expression, and reduce the craftsman in India to an automatic machine for reproducing departmental patterns imported from Europe. It is such conditions which have made craftsmen in every part of the world lose proper pride and pleasure in their work, and have made "jerry-building" and other forms of dishonesty as common in India as they are in Europe. The commercialism which Mr. Begg deplores has only been brought into Indian architecture by the Public Works system which ignores the art of the Indian Master-builder and puts in his place the building contractor whose only interest is to extract from the public purse as much profit as he can. It is inevitable that such a system should demoralise all the craftsmen employed

in it. The better class of Indian craftsmen will generally have nothing to do with it.

If the Consulting Architect were put on special duty to study the state of Indian art where it has not yet been contaminated by Western commercialism, I am confident that, like Fergusson, he would find a plentiful supply of the most able craftsmen and designers who would be quite capable of supplying all of India's architectural requirements, if departmental rules which block their approach to the public service were reasonably modified to meet the conditions under which self-respecting Indian craftsmen are willing to serve.

The fact that these master-builders are generally illiterate was not an obstacle to their employment in the magnificent building operations of the Moguls—their greatest ruler and statesman, Akbar, was himself illiterate. Nearly all the famous master-builders of Europe were probably as illiterate as they are, and it was not until 1646 that the antiquary Elias Ashmole, together with Colonel Mainwaring were admitted into the English craft guilds as “gentlemen” freemasons. The distinction which is now made between an “architect” and a builder dates from this innovation. The “architect” was a wealthy amateur archæologist who had made the *grand tour* in Europe: he sketched his architectural fancies on paper and employed the professional to knock their crudities into practical shape. The introduction of this dilettantism into the practice of European architecture; the making of the master-builder a subordinate to the “gentleman” architect, was the beginning of the decadence which overcame it a century afterwards.

The introduction of the same system into departmental practice in India has brought about exactly the same results—the lamentable deterioration of all the crafts

connected with Public Works architecture of which Mr. Begg complains. The more practical training which only within the last twenty years has been given to the English architect, and the better education of the builder, have approximated modern architectural practice in Europe more closely to that which obtained in mediæval times, but the modern school of professional architects has not yet established a reputation as great as that of the illiterate master-builders, whose works are still the classical models for the whole of Europe.

When, therefore, Mr. Begg speaks of himself and his professional colleagues as being a "new breed of architects" in India, and only looks to the training of educated Indians for supplying the professional assistants of whom he stands in need, he is treating the question from an European and departmental standpoint, and ignoring the larger aspects, the public interest and the development of Indian art and industry, to the consideration of which he has evidently not given sufficient study. It would, no doubt, be somewhat inconvenient for departmental officials to spend time in explaining their requirements to illiterate Indian workmen, and it might involve some sacrifice of educated *amour propre* to admit that in art matters the illiterate Indian craftsman may have something to teach the literate: but, after all, departments exist for the public, not the public for departments, and if it can be shown that departmental procedure is undoubtedly blighting the development of a most important Indian industry, surely it is time for the department to move in a different direction. Why should it be more difficult for professionally trained European architects to adapt the living traditions of Indian building to modern departmental requirements than it was for the amateur court officials who controlled the Mogul architectural works to make use of Hindu builders in

carrying out Muhammadan ideas of building? There is no reason, except the lack of imagination: the common official explanation has been that the living Indian building styles cannot be adapted to modern utilitarian needs: this is merely a confession of departmental incompetence--one of those convenient but flimsy screens which officialism uses to protect itself from public criticism. It is one of the first principles of architectural practice in Europe that the designer should make use of any local tradition of construction or design. Why should this sound architectural principle be discarded by the European architect in India, where architectural and craft traditions are much stronger and more alive than they are in Europe? If the recently appointed professional architects, whom Mr. Begg styles "the seven newly imported architects of India", follow the example set by himself in ignoring the living traditions of Indian building, it would have been better for India if his department had continued the old happy-go-lucky amateur system, for a few of its former amateur architects have tried to follow Indian traditions, though generally from an archæological rather than from an architectural point of view. The professional architect, as in other branches of art, when he is sent to India is too apt to follow the groove in which he has been set by his European training, especially when he finds that Indian departmental procedure fits best into his special groove and that his superiors are inclined to regard with disfavour any new departure which disturbs the traditional office routine.

Mr. Begg's professional zeal is highly commendable: he wishes to inspire the Indian artisan with some of his own enthusiasm for "sound, honest, joyful work," which, as he truly says, is the very foundation of a nation's progress in civilisation. "Then the crowds of Chinese

carpenters and smiths, for instance, who have obtained a practical monopoly of their respective trades in Calcutta and elsewhere, would soon have to pack and go." But if he would change places with the Public Works artisan for a week or two, or try to share his feelings, he would soon discover the reason for the Indian workman's apathy and want of zeal. The official expert's pay, promotion and prospects are assured: if his subordinates do good work the credit for it is his. If bad, he can throw the blame on the inefficiency of his staff. He can say to this man do this, and he doeth it (for fear of his superior's wrath if he doeth it not). But the humble Indian artisan who works out the foreign patterns of the official expert is entirely under the thumb of the contractor and Public Works Subordinate. If he does good work the contractor is displeas'd, for good work cannot be hurried and the contractor is always in a hurry to get his profits and finish the job within contract time. He has no power of initiative: he is not allowed to think, if he would do so. He must obey orders and copy the foreign patterns set before him whether they be good or bad, practical or unpractical. The contractor supplies him with the worst materials he dares to use, and pays him the lowest rate of wages he can. There is thus always a high premium set on inartistic and dishonest work.

Is it astonishing that under these conditions the public works artisan tries to scamp his work? That is only to say that he is human. The Public Works Department having by its own system of work demoralised the whole available labour supply in the great Anglo-Indian cities, has now recourse to Chinese carpenters and smiths in order to maintain a respectable standard of workmanship, and on account of their limited numbers they are able to dictate their own terms. Why is the

Chinese a better workmen than the lower class of Indian artisan employed by the department? Because he has managed to maintain his status as a self-respecting independent craftsman. He is free to come and go as he likes, for there is always sufficient demand for his work elsewhere. He never becomes, like successive generations of Indian workmen, the slave of the Public Works system; for as soon as he has made his little pile he departs to his native land and new comers with inborn traditions of free, honest craftsmen take his place. If Mr. Begg would use the power of his department for the benefit of Indian craftsmanship he must first find the means of restoring to the Indian craftsman some real incentive for honest, joyful work, and greater opportunities for the exercise of his intelligence and skill.

The Public Works Department, as Mr. Begg says, leads the way in Indian architecture. Unfortunately, I think, for Indian architecture that is the case. But is it the right or the wrong way? Is it true that the arts of India are dead, and that, as Mr. Cecil Burns, the Principal of the Bombay School of Art has declared, India is from an industrial point of view the suburb of Manchester and Birmingham? Or is it only that some official experts make the grave mistake of supposing that the conditions which belong to their own somewhat narrow departmental experience must also apply to the general state of that much larger field lying outside the range of their departmental practice? When I was making investigations for the Government of Madras into the conditions of indigenous industries I frequently found that some handicraft which the best informed local authority assured me was non-existent in that particular locality, was carried on at a very short distance from his own residence. I find it hard to believe that because Indian art has not yet made itself known to

some official experts, it has come to a sudden and untimely death in the few years since I left India. The hand-weaving industry, the largest in all India, remained similarly unnoticed by official experts for a space of fifty years, and if the fact of its existence had not been made known through the Indian press it would probably be officially dead even now.

These authoritative semi-official announcements of the death of Indian art, which have been rather frequent of late, are, I think, much to be deprecated. For, assuming that there might possibly be some spark of life yet left in it, the outspoken declarations of official doctors that its case is hopeless can only be very injurious to its prospects of surviving, besides preventing those remedial measures being taken which might lead to its recovery. It would be very much to the advantage of Indian art if it placed itself in the hands of more discreet and more optimistic advisers. My own experience has been that there is very much more vitality in it than is generally supposed, and that it responds very quickly to sympathetic treatment. When I first went to Calcutta I was told by everybody that nothing could be done for art in Bengal, except to regularly import a little direct from Europe--the only plan still recognised by the Education and Public Works Departments. The indigenous art, it was said, was quite dead and past praying for. It was even doubtful whether art had ever belonged to the Bengali's constitution. Nevertheless I soon detected some signs of life in it, and how Bengali artists are leading all India (in the only possible direction for art's healthy progress towards maturity) and I hope for Indian art's sake that it will not be long before it is considered quite superfluous to call in any more European doctors to prescribe for it.

In the same way with Indian architecture, the first

thing to be done is to totally disregard all these semi-official rumours of its decease, and to start work on the assumption that it is very much alive. The India Society of London, which has allied itself with the Indian Society of Oriental Art in Calcutta, recognising the importance of this architectural question for the future of Indian art, lately put before the Secretary of State for India a proposal that the officers of the Archæological Survey of India should be instructed while they are on tour to take photographs of any interesting buildings, either temples, mosques or domestic buildings, designed and constructed by living Indian Master Builders in the traditional styles of Indian architecture and to collect information regarding the local rates of pay for the principal craftsmen employed in them. The Government of India has sent a sympathetic reply to this proposal and given the necessary departmental sanction for carrying it out. The Society has since addressed all the Princes and Rulers of Native States requesting that similar investigations may be made in the territories outside British India, where the Indian master-builder has generally a better status than he has elsewhere. It may be hoped therefore, that before long the Society will be in possession of some very valuable data which will throw much needed light on the capabilities of the modern Indian builder and the condition of the indigenous building industry, throughout India. It is much to be desired that these official investigations should be supplemented by local private efforts and the India Society would be very glad for the co-operation of all who are interested in the welfare of Indian art, whether they are members of the Society or not (1).

It is, perhaps, too much to hope that the Public Works

(1) The Honorary Secretary is Mr. T. W. Rolleston "Ardesvin" Christ Church Road, Hampstead, London, N. W.

Department, when the existence of a living architectural art in India is revealed to it, will at once remove the blockade which has acted so injuriously on the Indian builder's craft for so many years. And, unfortunately, the native master-builder of the present day, having lost prestige and been deprived of opportunities of dealing with modern methods of construction on a large scale, would not, perhaps, be found at once capable of adapting his methods to modern European practice in building: though it is highly probable that a return to the simpler traditional methods of the Indian craftsman, under competent Indian or European supervision, might lead to greater economy as well as efficiency in Public Works administration, always wellknown for its extravagance. That is another point in which more light is needed. There is no doubt that the work of the independent Indian master-builder, even in the present day, though smaller in scale than the largest Public Works undertakings, is more than equal both in design and construction to the best the Department has ever produced, and it is most desirable that Municipalities should be encouraged to make a beginning in giving him employment in local undertakings now generally entrusted to the District Engineer or to a Public Works subordinate who in architectural matters is entirely an amateur. When the Indian master-builder's capacity has been proved in these smaller official undertakings the way would be prepared for employing him in those greater ones in which his forefathers did such splendid service to the state.

Practical measures of this kind would do far more for the advancement of Indian architecture and industry—without throwing any additional charge on the public purse, but actually tending to greater administrative economy—than any expensive schemes for the training of

Public Works subordinates in modern European architectural practice. All educational schemes in India which ignore the existence of Indian art and craft—whether they be connected with general or technical education—are wasteful, extravagant and radically unsound in principle. The right policy in technical education in India is to organise the millions of skilled craftsmen, to teach them to make the best use of their skill in adapting it to modern needs, and to increase it by enlarging their opportunities of service for the public advantage. The wrong one, which generally receives official recognition and is considered “progressive” by leaders of Indian opinion, is to spend large sums of public money in the endeavour to create a new class of commercially trained literate middlemen, with sufficient technical knowledge to exploit for their own advantage the hereditary illiterate artisan and prevent his intellectual and social advancement, that is the surest way of making all India a suburb of Manchester and Birmingham ; of obliterating all that is valuable, both in a spiritual and material sense, in her traditional culture and civilisation ; of keeping her always behind the progress of Western nations, and of inflicting on future generations the untold social miseries which have brought the storm-clouds now fast gathering over Western industrial life.

It would be a great gain to national progress if our educationists and administrators would learn to appreciate the illiterate handicraftsman’s skill as an intellectual factor in civilisation, and not rely only upon percentages of literacy or illiteracy as an infallible index of intellectual and spiritual advancement.

I have laid so much stress upon the official attitude towards this architectural question only because, in the absence of any decided public opinion on the

subject, official action must have a paramount influence on the prosperity of Indian architectural art. I do not flatter myself, however, that my words will have any effect upon Public Works policy unless public opinion can be roused to recognise the vital importance of the building industry in India's economic system. My efforts to stir up official interest in Indian hand-weaving failed to produce any effective action until I was backed up by a strong body of public opinion. Even now official schemes for the benefit of the hand-weaving industry are generally distinguished by their futility, and in practical, well thought out projects for the village weaver's benefit the Salvation Army seems to be leading the way. In the building industry also, though the action of the Government of India, through the Archæological survey, may bring to light the existence of Indian architecture, public interest in the subject must be aroused before any practical help is likely to be given to the Indian builder. This is a matter which rests almost entirely with Indians themselves. If Indian Princes and other wealthy employers of Indian artisans would endeavour to grasp the economic and artistic bearing of this architectural question, and cease to leave their artistic consciences in the keeping of European experts and non-experts, the Indian Master-builder would soon come to his own again; the future of Indian architecture would be assured, and all classes of Indians would be greatly benefited thereby.

SOME ASPECTS OF INDIAN COMMERCE AND INDUSTRY.

BY G. FINDLAY SHIRRAS, Esq., M. A., I. C. S.

(ON SPECIAL DUTY.)

Finance Department, Government of India, Calcutta.

The title which I have chosen for this paper admits of numerous forms of treatment. I might describe to you the vast trade of this great empire—an empire which is a land of many countries, I might dilate on the numerous expansion of Indian trade during the last few decades especially with Great Britain, the United States, Germany and China. I am, however, not to expatiate on this topic except incidentally. My aim is rather to devote myself to Indian industrial developments and to the question of Indian tariffs. My chief aim is to show how the future of India is inseparably bound up with its industrial developments. India will require in the near future a systematic development of its resources and the organisation of a trained industrial population. After one tours in all parts of India, he cannot but come to five conclusions :—

Firstly that India perhaps more than any other country in Asia is in the throes of a great transition and this transition is marked in questions affecting industrial developments. The village in India is no longer a self-contained economic community and the impact of the west is responsible for this change. In Bengal, Madras, Bombay and in the United Provinces one sees vast industrial enterprises being undertaken. India's wealth is now, if ever, being produced by the organisation of industry. Organisation has been seen to be imperative ; the industrial regeneration of India can be effected by no other means.

Secondly—Agriculture is and must remain by far the most important of Indian industries and the essential basis of India's prosperity. Two-thirds of the population subsist on agriculture.

Thirdly—Indian agriculture is in a distinctly backward position; there is much waste, and production is not what it might be. It is impossible to generalise about Indian agriculture. Dr. Voelcker some 20 years ago contested the popular belief that Indian agriculture is primitive and backward. One cannot deny that Dr. Voelcker was rather optimistic, and in every country of the world the application of modern scientific principles has been exceptionally beneficial, and there seems no reason why Indian methods of agriculture should lag behind those of other countries. In the United States, in Australia and in many European countries enormous advances have been made in recent years. We have, it is true, greater difficulties than those countries, because we are not dealing with a population of four millions dependent on the soil but with a population of two hundred millions, and the co-operation which is essential to success is not always forthcoming. There is the additional difficulty of the ryots' holdings being small and in most cases their being scattered over different areas in the same village, or even in different villages.

Fourthly—This is the labourer's day. Labour is scarce and the scarcity is felt in all parts of India, especially in the Punjab. Labour too in the long run is expensive. I mean in proportion to its result labour is not cheap. Every one hears Indian employers complaining of the scarcity of labour. I think the real cause is unquestionably the state of transition to which so many of India's present difficulties must be ascribed. Factory labour is not yet very popular, and the recruitment of this labour is not very well organised. An employer of Indian labour has pointed out that the object of the factory hand first and foremost is to get to pay day by the easiest possible route. Added to this is the habit of the men to throw themselves recklessly out of employment, because they know that the joint family or friends will support them when in need. We must remember that the Indian labour is inefficient not so much from lack of capacity or inherent laziness but because

the workers will not regard the work in the mills as their permanent calling in life. The factory system in other words is entirely alien to Indian ideas and tradition.

Fifthly—There must be a much more efficient and widespread system of technical education, and men are required with high qualifications who are capable of controlling big factories and even of starting industries on their own account. There are it is true admirable institutions such as the Engineering Colleges of Poona, Roorkee, the Sibpur Civil Engineering College near Calcutta, the Engineering Schools of Dacca and Bankipore, the Victoria Jubilee Technical Institute in Bombay and the Indian Institute of Science at Bangalore which is a magnificent project of the late Mr. Jamsetjee Tata. The need for elementary technical education suitable for boys and girls who do not aspire to be more than working artisans is essential.

These are the axioms which we must premise before dealing with any question of Indian Commerce and Industry. It is necessary also to add that these topics must be approached with a clear gaze and a good conscience. Now-a-days we take too pessimistic a view of Indian Economic problems and not a few of us are of the firm belief that human ingenuity and energy cannot solve them. We require a more sympathetic treatment of Indian economic questions and at the same time we require statements, undisfigured by those vote-catching sophisms which make current literature such unprofitable reading. Statistics are the straw out of which economists have to make the bricks. "The Statistician" says Mr. D. E. Wacha "is the great purveyor who supplies the Economist with the facts on which to build his sound and sure economic postulates and economic arguments, apart from fresh hypotheses and corrected or new theories. The Economist mainly treats of phenomena relating to groups of facts, each group being a watertight compartment by itself. But he has to go to the statistician for his fundamental materials." The chief drawback in Indian economic discussion to-day is the utter lack of reliable statistical data which have been

treated scientifically; facts must be scientifically collected, sifted and analysed and from these facts only can a theory be formulated. Fragments of pure theory, only true under certain ideal conditions, must not be paraded as actual facts, easily realisable in every-day commerce and industry. For example, how many there are who forget that the most important portion of the data from which the science of Economics reasons, is human character and human institutions, and everything consequently which affects that character or these institutions must create new problems. In India, the labourer is usually his own master, and in addition to supplying labour necessary for production of wealth he undertakes also the risks of production which in Europe are borne by the employer. It is obvious that such a country cannot compare with that of countries in which industry is directed by technical skill, administrative ability and ample capital. The religious ideals of life preclude the Indian from an ardent pursuit of wealth, and moreover the laws of inheritance among the Hindus encourage the subdivision and not concentration of wealth. Peace and security, rather than accumulation and possession of wealth, are what the average Indian wants. In dealing with questions of Indian economic conditions we must not jump at hasty conclusions. If a fur coat is good for a Canadian winter, it is not equally so for an Indian cold weather, nor is a dhoti (so suitable for India) equally suitable for Canada.

INDIAN PROTECTION.

India is frankly Protectionist.

Yet curiously enough she is the one country which most requires strong Free Traders who will analyse this uncritical protectionism in order to discern whether or not, if protection did come, tariffs would not bolster up industry after industry at the expense of the community. Conservatism in production—the chief weakness of Indian industry—may be perpetuated by an indiscriminate protective tariff.

We must be careful for protection is often found to rest less on reasoning, than on sentiment.

EXPORT DUTIES.

Two essentials in discussing export duties are frequently omitted *viz.*, (1) that an export duty cannot be supported by a corresponding excise duty as in the case of imports and (2) the outside country is practically the whole commercial world. If a protective duty is levied, the outsider or foreigner will pay the whole or in part, provided he does not manage to obtain substitutes, and provided the demand is intense. To-day the possibility of finding substitutes is increasing rapidly. In discussing the economic propriety of export duties we may lay it down as a general rule that export duties should not be levied by India except where she has a monopoly of supply of the commodity on which the duty is put, or such advantage in its production as to approximate to a monopoly. The export duty of cinnamon in Ceylon is of importance as illustrating the case in point. When Ceylon had a monopoly of that spice it was very profitable. It was dropped in 1838, too late to save the Colony's pre-eminence in the export of cinnamon. Similarly in India in 1857 there were export duties levied chiefly on grain, rice, indigo, lac, opium, silk, tobacco and native manufactures. Since 1860 these have been abolished with the exception of rice, opium and a few other commodities. The duty on rice is economically justifiable, owing to exceptional producing power possessed by India, the exporting country. Almost the entire supplies of the cereal sent to foreign countries are drawn from Burma, the granary of India, and it is employed not merely as a food grain but also for distillation and in the manufacture of starch. Great economies are effected in the production particularly in the Burma rice mills *e. g.* the husk is conveyed by special contrivances to furnaces and there consumed, while a stream of water below carries off the ash. We owe much to European capitalists, for it is to them that the credit of this prosperous industry is due.

Another advantage in production is due to the fact that the monsoon never fails in Burma. Bad seasons, however, in other parts of India are apt to cause the diversion of rice which ordinarily would have been exported to foreign markets. Some hold that the case for rice export duty to-day is hardly so good as formerly, owing to the fact—firstly that there are several substitutes for rice in starch manufacture and secondly that the value of raw jute exports is much greater than rice and therefore a monopoly (*e. g.*, jute) might be a more fit subject for an export duty. If there is, as some argue, a probability in the future of the supply not proving equal to the demand, an export duty would be still more advantageous to the producers (*i. e.* to India) generally.

IMPORT DUTIES.

Import duties are generally supposed to be paid ultimately by the consumer, as was ostensibly the case recently in the new duties on tobacco. In the United States of America and other productive countries, it is argued that the exporting country abroad pays. Most usually the import duty falls on the consumer. Suppose protective duties on cotton were to be re-imposed, as previous to 1879, without an accompanying excise duty; what would be the result if there were free markets in other parts of the world where Lancashire could send her cotton? Less cotton would be sent to India, unless India paid the duty, which is unlikely. The paying of the duty would check the demand; hence the reaction on the production of manufactured cotton in Lancashire. But so far as Lancashire supplies so much cotton manufacture, she will bear part of the duty. The price of cotton manufactures in India will rise, but in view of the modern system of production, the price will never rise to the full extent of the tax. Should an import duty be put by India on a commodity which she takes only in small quantities relatively, and if the supply can be readjusted easily, and if there are other free markets, India will pay as consumer.

the whole of the tax, and the price may rise more than by the amount of the import duty.

It is impossible to concede without a detailed examination of Indian industries whether any or all of them would be better off under a system of protective tariff. After a somewhat detailed analysis of the various industries I find that no protection is possible at present for our jute manufactures, our paper-making, coal, tea, indigo, and coffee interests. Protection or bounties, however, may be possible on iron which is important to other industries, cotton, tobacco and petroleum. I am uncertain with regard to silk and sugar. It is impossible to arrive at these conclusions except after careful deliberation as it is always dangerous to dip into India's purse on the ground of manifest simplicity of assisting Indian industry. During the last 10 years the petroleum industry has developed to an astounding degree ; in 1898, 190 lakhs of gallons were produced of which Burma produced 184 lakhs or 97 per cent. of India's produce; ten years later the production had increased to 1,520 lakhs, of which Burma produced 1,488 lakhs gallons. This means an increase of 700 p. c. Almost the whole supply comes from Burma and Assam, and very little from the Punjab. In spite of the progress that has been made, it is curious that India imports mineral oil to a value equivalent to two and a half times of her own output. There seems good chance of expanding an industry at the expense of the United States, Roumania, the Straits Settlements, Sumatra and Russia.

INFANT INDUSTRIES.

England has certainly prospered under Free Trade and she has been free from many of the incidental dangers of protection. Still, however, there is no need of adding in view of this, "Free Trade" as an eleventh commandment to the Decalogue. India, it must be remembered, is not pre-eminently fitted to become a great manufacturing country in the British or American sense of the term. There is, however, scope for diversified industries

which she already possesses potentially. To the infant industries argument, economists have always conceded the greatest weight, whether the argument is urged in a special or general form. There are as you know risks and difficulties which always attend the domestication of new branches of production. If a country like India is agricultural and has no large and important classes of artisans and factory workers, the skill required for commencing any kind of mill will be exceedingly difficult. Competition with established foreign rivals will be impossible in spite of the fact that the country has great natural advantages. Once the industry which is being domesticated has been wisely chosen and the initial difficulties have been overcome, the duty should be withdrawn. Such a policy will mean a burden on those who consume what is produced by that industry, but the supporters hold that once the infant is vigorous, there will be more than a compensating gain, or in other words, the crutches to teach the new manufacturers to walk, may teach them very much earlier than the industries should otherwise have learned to do. Accordingly the cost of the crutches is more than repaid. There are many difficulties as for example, the length of the period for such protection. In India one industry may require even 30 years, while another but 15 or 20. Moreover, it is most difficult for a Government to use the argument fairly and honestly. Behind a tariff wall, there will be a number of industries which can never exist without it, and it is a far wiser policy to let these die than be a burden. Protection is, as the term itself implies, and as the American tariff on woollens, and the French and German agricultural tariffs have demonstrated too often, a policy for the weak and not for the strong. Ah! Gentlemen how often do we find the motive power behind a tariff, a chronic clamour of self-seeking classes without any spirit of philosophic contentment!

THE "DRAIN."

There is an aspect of Indian commerce and industry which during the last few years has been of special interest

to many Indian gentlemen. I refer to the so called " Drain " which ostensibly means that there is an excess of exports over imports annually and, *ipso facto*, a drain of wealth is taking place. It is inopportune to weary you with economic reasonings (sometimes exasperatingly dull) as to how imports and exports balance one another and how there are many more imports and exports, than are dreamt of in the philosophy of our commerce and industry returns. During the last few years, the United States, probably the richest country in the world, has an excess of exports over imports of Rs. 142 crores, Russia Rs. 51 crores, Australia Rs. 23 crores, Brazil Rs. 22 crores and the Argentine Republic Rs. 17 crores ; India's excess of exports over imports averages Rs. 27 crores ; on the other hand Persia imports more than she exports and yet she is certainly not rich nor does she enjoy successful foreign trade. Indian statistics are frequently misread and how frequently are they the real spawning ground of much misunderstanding and of much vilification of economic problems to-day ! The reason of this excess of exports over imports is due in the first place to economic status and not to political status. Of these countries mentioned above the majority consisted of young countries whose stores of wealth have just been tapped while the others (pre-eminently among which are India, Servia and Roumania) had an *effete* industrial organisation which was now being displaced by a more up-to-date organisation that will go far to make competition fairer. Again, there is an increase of wealth to the owners of land and to workers themselves, as well as to capitalists. Australia fully realising the truth of this, willingly pays to Great Britain annually Rs. 23 crores as interest and she has but 40 lakhs of population—and 1/100th part of the accumulated wealth of India. Some may argue that so far as the excess of exports over imports represents interests or capital invested no objection can be taken. It was to the sums paid owing to India's political connexion that exception is taken. The sum is no longer Rs. 27 crores but Rs. 9½ crores.

Payments in connexion with Civil Depart-			
ments in India	...	...	Rs. 26 lakhs.
Army and Marine effective charges	...	..	127 "
India office	...	..	32 "
Furlough allowances	...	..	127 "
Pension and gratuities	...	..	666 "
			Rs. 9 $\frac{3}{4}$ cr.

This sum of 9 $\frac{3}{4}$ crores is not tribute because a tribute is payment exacted without equivalent services but this sum in question is a payment for work done, for services rendered. As a distinguished Indian (Mr. Justice Ranade) said, addressing his own countrymen "It cannot well be a mere accident that the destinies of this country have been entrusted to the guidance of a nation whose characteristic strength is opposed to all our weaknesses, whose enterprise in commerce and manufactures knows no bounds, whose capital overflows the world, whose view of life is full of hope, and whose powers of organisation have never been surpassed."

Let me say a few words more as Parthian Shots. Great Britain's credit enables India to borrow in the money market on terms which she could not do otherwise and this saving more than compensates for the cost of services. Japan with all its infinite capacity for taking pains, and with all its hard study of that branch of economics (which is called Finance) cannot borrow so cheaply as India. Japan pays for her loans 8 per cent. while India were she independent could not borrow at a lower rate than 6 or 7 per cent. This saving of 2 $\frac{1}{2}$ per cent. on her present permanent debt would be a little over 9 crores of rupees, equivalent almost the sum which forms the Home charges for the services which India receives. Again India enjoys free of charge the use of the Ambassadors as well as consuls of His Majesty's Government, throughout the world. This huge saving cannot be estimated with accuracy, but it is indeed great. Lastly India enjoys the services of the British Navy. The Navy costs some Rs. 44 $\frac{1}{2}$ crores a year

(for 1909 the estimates were Rs. 54 cr.) India contributes but a modest lakh. At the same time we admit with the heartiest satisfaction and deepest sense of pride that the Indian Army is a source of strength to the British Empire, when, however, we total up the debits and credits we certainly find India receives more than she gives. I hope then that this, although one of the most curious of paradoxes, will appear to be one of the most transparent of fallacies.

INDUSTRIAL DEVELOPMENT.

I come now to the question of industrial development and though I shall treat it briefly, I hope I shall not be considered dogmatical. The development of industrial undertakings and industrial education is certainly one of the foremost of administrative problems especially in those provinces where there are rich resources not yet systematically developed and where too unfortunately there is little aptitude or enterprise shown in utilising them. Gentlemen, we must not be blind to this principal cause of the failure of Indian industry. There is an awful lack of enterprise in agriculture, hand-loom weaving, sugar production, oil-pressing, not to mention the production of manufactured articles of a complex character. Cotton weaving *e. g.* is conducted on archaic and exceedingly wasteful lines. I have already referred to Indian agriculture and it being the principal industry of India no consideration of the industrial development can be complete without a reference to a topic which roughly requires special treatment.

AGRICULTURE.

Agriculture means the culture of the people who live on the soil, as well as the cultivation of the soil itself. Our chief difficulty lies in the fact that Indian agriculture is in the hands of small men, the capital is required in small sums, and it is supplied by small capitalists to men of small commercial intelligence at anything but a small rate of interest. During my

tours in the United Provinces, Bengal, Eastern Bengal and Assam, Central Provinces and the Bombay Presidency I was much struck by the lack of real practical knowledge amongst the ryots who are conservative to a fault. Many conclusions arrived at agricultural colleges in this country are never heard of even by the better class cultivators. We perhaps are to be blamed slightly in this matter. There is only one way of improving the ryots' welfare and that is the eternal truth of getting into their skins, of realising their ideas and feelings. When once we see their point of view we shall guide them with greater ease to adopting improved methods of agriculture. Then will they take to improving their jute crops, *e. g.* in cultivating a whiter fibre, in growing jute in rotation with paddy—a very profitable and economical enterprise—in planting and transplanting paddy more carefully and cheaply and in cultivating new staples. The Soy, bean for example, has undoubtedly enormous interest for India and a struggle between bean oil and cotton oil in the soap countries in the world has already begun. If its introduction into this country is successful there should be little difficulty in competing with Manchuria. Dry Farming which has been so successful in America might be introduced in a larger degree. Dry Farming means roughly the cultivation of drought resisting plants and also the most advantageous use of rainfall on the soil by careful preparation. A great deal can be done in the way of co-operation whether in the form of credit societies or of supply societies *e. g.*, for providing the materials of agriculture, productive societies *e. g.*, co-operative dairies and sale societies such as lac or grain societies. When in Eastern Bengal and Assam I found some startling rates of interest. Three villagers borrowed a maund of rice when the market price was Rs. 6 per maund. Not being able to pay in cash they made a bond for Rs. 7 stipulating for interest at 150 per cent. compounded every three months. In less than three years they were sued for Rs. 200 and the Munsif decreed the entire claim. In another case three villagers executed a bond for Rs. 9 for cloth purchased

stipulating for interest at $187\frac{1}{2}$ per cent. every quarter. The same Munsif gave a decree for the principal with simple interest at 75 per cent. I know of another case where 2 men took a loan of Rs. 15 at Re. 1 interest a day which comes to 2,488-1-8 per cent. yearly. At the end of three years an *ex-parte* decree for a claim of Rs. 999 was given. There is scope for a more extensive use of agricultural machinery, but sufficient attention will have to be paid to the peculiarities of local agricultural methods. The work of Mr. W. H. Moreland, Director of Agriculture, United Provinces, has been very successful in this respect. Co-operative rural societies may own jointly agricultural implements and will decrease the limitations imposed by the scarcity of capital in agriculture. Bengali ryot like his frater in the Deccan is supremely critical of any machine containing unnecessary parts or whose utility is not obvious. Superficial finish of machines *e. g.* highly varnished and coloured metal surfaces so attractive to the European is not desired by the Indian cultivator. There are local peculiarities *e. g.* the ryot of Eastern Bengal and Assam does only about $\frac{1}{2}$ or $\frac{2}{3}$ of the work of an efficient English labourer, his pair of bullocks can do but $\frac{1}{2}$ the work of an English pair of horses. His oxen are trained to go counter-clockwise and gears must be designed accordingly. The flexor muscles are better developed than the extensors so the ryots work more effectively with a drawing than with a thrusting stroke. Lastly he would rather sit down to turn a horizontal wheel, than stand up and turn a vertical wheel for a much shorter period.

WEAVING.

Of industries closely allied to agriculture weaving is the most important. 80 per cent. of the weavers in Eastern Bengal and Assam are engaged in agricultural pursuits. Dacca has always been famous for its muslins—Abrawan or "running water", Bafthwa or "woven air", Shabnam or "evening dew", though these are almost a thing of the past; and the demand in Europe for the old cotton

flowered and sprigged muslin has almost entirely fallen off ; when Burk prepared his impeachment of Warren Hastings the output of muslins and silks of Dacca was declared to have an annual value of Rs. 52,50,000. Though this sum is probably exaggerated yet in Europe there was an exceptionally huge demand for these celebrated goods. To-day European taste has entirely changed and chiffon and similar substitutes have taken the place of Dacca muslins. Another reason for the decline is that there is an increasing sale of Japanese silks. A few years ago, I got three grades of chiffons from London and the prices were roughly -/12/, 1-and 1/7/- Prices of similar grades of Dacca muslins are about 13 or 14 annas and one rupee thirteen annas to 3 rupees ten annas a yard. The chiffon indeed looks even better than the local muslins. The salvation of weavers does not lie in the adoption of large and often expensive looms. It will be more expedient, firstly to utilise existing looms to better advantage by slight alterations which will increase the yield in many cases to 30 per cent., and secondly to assist the weavers to buy yarn cheap and to sell their products dear. There is no use at present for a central weaving school in Dacca until we have first looked to these points. In Eastern Bengal and Assam quite 75% of the weavers are dependent on Mahajans. In many provinces that I have visited, a weaver gets very little more than the cost price in good seasons and very much less than this price in bad years. What is wanted is an organisation to enable the weavers to dispose of their wares as economically as possible. There is no need at present for large expenditure on bricks, mortar, and laboratory appliances. Our industrial development is not, as many are apt to think, a matter that can be hustled and hurried.

SUGAR.

The most striking fact of Indian Commerce in recent years has been the tremendous and unparalleled expansion in our sugar imports. This is specially phenomenal when

we remember that India is probably the largest produce of sugar in the world and sugar is indispensable for a warm country like that we live in. It, however, cannot be said that the cultivation of sugarcane in India is contracting seriously because of these imports. We have to remember that the sugarcane in India is often grown in small patches which defy estimate and moreover the great mass of the sugarcane of this country is not converted into crystalline sugar but is consumed in the form of crude sugar or gur which is more nutritious than refined sugar. It is at the same time impossible not to believe that this huge importation of foreign sugar at the rate of 107 lacks of cwts. yearly or nearly 2 seers per head of population can be continued without affecting the internal industry as a whole. You ask then what is to be done? We are not taking pains enough in the struggle for markets. We ought to develop the central factory system *i. e.* factory situated in the centre of a tract of land reserved for sugar and its rotation of crops only. The cane is then as near the mill as possible and cultivation, cutting etc., can be done with the least possible waste. The complete triumph of this system is seen in the regeneration of the sugar industry in Formosa by the Japanese, and in Porto Rico. The Java planters according to the British Consul in the island, are devoting a large portion of their profits to improving their methods of production, while steps are being taken to provide better transport and machinery of the latest type. The price of imported sugar will fall probably as a result of this and Indian sugar will be subject to serious competition in its own markets. A protective tariff, I do not think, will cure this lack of enterprise. The ryots are strongly averse to using effective crushing mills. The most suitable mills are the three roller mills and these might be purchased by some of our rural co-operative societies. At the Allahabad

Exhibition, the Hadi plant proved its excellence and sugar making by this process among better class cultivators would be profitable. In some provinces, there is great need for the Central Factory system. In Eastern Bengal and Assam, the East India Company had extensive mills and even to this day, there still remain some large sugar factories. In Rangpur especially as the district has a belt of country on both banks of the Jamuneswari suited for cane cultivation there are special advantages for a central factory.

I cannot go into detail in the present paper with regard to the production of goods of a complex character on a large scale by up-to-date methods. It is necessary, nevertheless, to refer to the importance of choosing a good locality in which raw material and fuel can be obtained cheaply, and from which goods produced can be readily transported to the consuming markets. There is need also of obtaining well-paid skilful artisans as the results of the experiments of employing captains of industry on this basis has been exceptionally successful in Japan. We must not forget that Indian industry is limited by capital. Without capital, land cannot be cultivated, mines cannot be worked nor can factories be constructed. We are apt to think that laws and governments can create industry. This is seen in the argument for protection to native industry as the sole panacea. Government is playing a noble and generous part in increasing the efficiency of labour by education and sanitary legislation and it is thus enabling capital to do more work. When all is said and done it still remains true that one of the real limits to industry is capital.

CAPITAL.

The investment of British Capital in India has been discussed at length in two interesting papers read by

Mr. George Paish before the Royal Statistical Society in 1909 and in 1910 respectively. Mr. Paish remarks: "No one can doubt the beneficent effect upon the prosperity of India of this expenditure of British capital for the development of the natural resources of the country, and the linking up of district with district, which has so powerfully helped to diminish the severity of famines. The great sums shown below have been lent to India at an exceptionally low rate of interest, and having regard to the immense increase in the wealth of the Indian people which has resulted, and is resulting, from the construction of railways, the burden of the low interest charge is quite negligible". The details being as follows:—

	£ (000's omitted)
Government	178,995
Municipal	3,522
Railways	136,519
Banks	3,400
Commercial and Industrial etc.	2,647
Electric lighting and power	1,763
Financial, land and investment	1,853
Gas and water	659
Iron, coal and steel	803
Mines	3,531
Motor traction and manufacturing	90
Oil	3,184
Rubber	4,610
Tea and coffee	19,644
Telegraphs and telephones	43
Tramways	4,136
Total	365,399

It is interesting to note that Australasia has borrowed 380 millions, Canada and Newfoundland 373 millions and

South Africa 351 millions, the United States 688 millions and Argentina 270 millions, followed by Brazil, Mexico and Japan with 94, 87 and 54 millions respectively. Mr. R. N. Mukerjee, C. I. E., an eminent Indian business man, in the course of his Presidential address at the Indian Industrial Conference in 1910, said in words which must be repeated. "Indian capital is proverbially shy and unenterprising, but this I ascribe largely to a want of industrial and commercial knowledge on the part of Indian capitalists, and consequent failure to realise the potentialities of the various schemes placed before them, coupled with a disinclination to depart from those time-honoured methods of investing and lending money, which have been in force for so many centuries and in many instances, bring in a return which can only be considered as usury. India, generally speaking, is a poor country, that is to say, the majority of the population are poor. But there is wealth in India, and the possessors of it could, with but a fractional part of their amassed wealth, not only develop many of the industries that are dormant to-day, but make India industrially equal to any other country in the world. We often see articles in Indian newspapers, or hear speeches from public platforms, condemning the use of foreign (English) capital for the development of Indian industries. But, I am afraid, those who hold such views do not seriously consider the question in all its aspects. Apart from the fact that foreign capital is only attracted by signs of peace and prosperity, and that we know that foreign capital is welcome in any other country for the development of her industries, an important consideration for us in India arises from the fact that, for our own good, it is wise to allow British capitalists to interest themselves in our industries, and thus take an active part in their development.

That industrial enterprise can be successful in India is amply proved by the many large and thriving industries, representing millions of capital which already exist, and it is a reproach to us, as a people, that practically the whole of these, with the exception of a certain number on the Bombay side, have been financed and developed by English capital and energy. It is true that when these industries were first started, our countrymen had little interest in, or knowledge of such enterprises, but that attitude is rapidly changing, and it should be our aim and endeavour to emulate the example set us by our English fellow subjects and to join with them in the industrial development of India." It is the fashion in some quarters to protest against the incoming of British capital. India could well do with more of it. Canada and the Argentine Republic are having their railroads constructed for them and are increasing their trade in a way they could never do without this capital. The bulk of the Canadian and Argentine shares have gone into railroad construction. India is credited with the comparatively small sum of Rs. 4½ crores for her railways including the much required feeder railways for developing new centres of industry. The opening up of communications has had a great deal to do with the increase of incomes of ryots and the industrial classes. Between 1875 and 1895 agricultural income rose from Rs. 26 to Rs. 35 or 39 per cent, the non-agricultural income from Rs. 28 to Rs. 34 or 18 per cent, and as these two classes were 97 per cent. of the population the average annual income of the masses had risen from Rs. 27 to Rs. 35 or 28 per cent. The income of all classes taken together had risen from Rs. 30 to Rs. 39 or an increase in the average income of 29 per cent. These figures have been carefully compiled and deserve high

respect. The increased prosperity consequent on the opening up of the country is seen in an increased consumption per head of salt, in a large development of excise revenue during the period, in the great increase of Savings Bank Deposits and in the decreasing severity of famines.

LABOUR.

I have already referred incidentally to Indian labour and I am afraid I have wearied you with some ostensibly cryptic observations. I had intended to show you how production was hungering for labour which is at present like an army without leaders. I should have liked to show you a very practical scheme of my own *viz.*, the formation of labour exchanges. This exchange would be concerned with the numbers, movements, and condition of labour. There is of course always the risk that Government might appear to guarantee the terms of employment, but this disadvantage could be easily overcome. It would be to the interest of the Government itself to furnish information which may guide it in legislation and it would be in the direct interest of the labourers so that employers and employed may be brought together without the evils of the present *Arkati* system. Similar schemes have been successful in the United States of America, in Switzerland, and more recently in the United Kingdom.

A great deal remains to be done with regard to our industrial development. As I have said a protective tariff has often been put forward as the best means to tend to an effective development. It is a contentious matter on which there is at present no necessity to enter into, but it may be observed that tariffs alone will not expand the industries of India. The Bombay millowners handicapped their own industry by unwise methods of finance and control which militate against prosperity far more than the

Excise duty. A pressing need for India to-day is the unlocking of hoarded capital which ought to be put to reproductive uses. The process has begun and its continuance is imperative to the industrial development of India. Twenty years ago, hardly any manganese ore was produced in India, but last year the quantity exported was 572,979 tons and the value was Rs. 91.9 lakhs. The advance on the previous year was therefore 14.5 per cent. in quantity and 16.2 per cent. in value. No attempt has yet been made to manufacture ferro-manganese. Again nothing has been done in regard to the manufacture of sulphuric acid on a large scale, as everyone knows that sulphuric acid is the key to most economic and to many metallurgical industries. This has been frequently manifested by Sir Thomas Holland. India pays 30 crores annually for products obtained in Europe from minerals identical with those lying idle in her own soil. A great deal is to be done in the utilisation in India itself of raw materials, such as oil seeds which are utilised in Europe and America for the manufacture of various articles of commerce. In the last two years, the share of seeds in the total value of raw produce exported, has been successively 17.4 per cent. and 22.4 per cent. In 1910-11 it rose to 26.7 per cent. If well organised oil mills are established, there is no doubt that the export of cotton seed would decrease but there is every likelihood of a ready sale for the manufactured article in the form of article of food and the edible oil might also form a suitable substitute for ghee of which the supply is now falling short of demand. Then again there is the case of paper. The raw materials for paper making are available in the country though not in an exactly accessible form. Large supplies of wood-pulp and wood meal could be made available from the forests of spruce and silver fir in the mountains and fibrous grass from the

forests at the foot of the Himalayas. Vast quantities of hides and skins are exported which ought to be manufactured into leather and enormous consignments of cotton cloth which might be made within India itself if the staple of her cotton was systematically improved. It is surprising to find that in the classical days of Greece and Rome three products of India attracted the notice of curious enquirers—a tree from which the Indians made cloth (the cotton plant)—a reed from which a sweet juice was expressed (sugar-cane) and a plant yielding a dark blue dye known as indicon (indigo). These are the very industries which are in jeopardy to-day. These plants were not known to the ancient agriculture of Egypt and Mesopotamia. India has found herself surpassed by America and Egypt in growing crops that were peculiarly her own. In Egypt the cotton plant produces four-fold, in the West Indies the sugarcane produces nearly threefold the return that they yield in India. And the cultivation of indigo now appears to be doomed by the manufacture of artificial dye in German laboratories. The Indian industrial progress has certainly been great during the last three decades but during the next two decades remarkable development will take place. We have to remember that the foundations of India's industrial prosperity have already been laid, her productive power is capable of infinite expansion, and the time is now at hand to improve Indian agriculture by strictly practical means so that its products can compete in the markets of the world, to extend her railways and irrigation, to coax British capital and above all to foster a strong spirit of co-operation. We must do away with hasty sentiment; we must go forward with a high heart and sober self-reliance. Let us hasten with caution for, as some one has said, the most tragic miscarriages in history have been due to the impatient idealist and surely he is not absent from our midst.

CO-OPERATIVE SOCIETIES IN THE CENTRAL PROVINCES AND BERAR.

BY H. R. CROSTHWAITE, ESQ., J. P., U. C. S.,

*Registrar of Co-operative Societies, Central
Provinces and Berar.*

The present Co-operative Credit Societies Act was passed in March 1904. In that year Mr. Dupernex sent a paper to the Sixth International Co-operative Congress in which the following words are to be found :—

“As yet the Co-operative movement in India is in its infancy. We have many well-wishers, but there is considerable scepticism as to the possibility of any real progress being made.”

Seven years and more have passed, and, although the movement is still in its infancy, there are distinct signs of sturdy development. There are, as before, many sceptics who stoutly deny that there has been “real” progress. Science, however, tells us that all living things have their uses ; and we may grant that the sceptic has his. He is a valuable critic, a thermantidote for the enthusiasm that is too hot. Looking back at the progress of the movement in these Provinces it is remarkable that not a few present co-operators have been recruited from the ranks of the sceptics. The man who has dropped co-operation after he has once taken it up in earnest has, however, yet to appear. What the co-operative movement most requires is a large number of zealous workers. Our list of workers is constantly being added to. In 1904 there were no workers at all ; at present there are about fifty non-official gentlemen taking an active part in organization. And, though progress has neither been great nor rapid, the reality of the advance made is beyond dispute.

2. The first village society in the Central Provinces was formed on the 20th June 1905. It was a very small

affair with 20 members and a capital of Rs. 240. In the same year the Harda Urban Society started work with 48 members and a share capital of Rs. 7,950. Both these early societies are still flourishing and their members value them highly. The Harda Society has made such progress that the time has come to grant members (who are mostly small trademen) the benefits of an ordinary bank account, and steps are being taken to reorganize on lines which will bring the advantages of the cash-credit system to the individual members of the society. Every member will be granted a credit, and the financial machinery will be so constructed that money can be drawn and paid back again as desired by the member. This step will mark a stage of progress which has been reached after a few years of steady work. At the close of 1905 there were in existence 9 rural societies and 1 urban society. The total membership was 639 and the total capital Rs. 10,345.

3. In 1906 the movement spread. New rural societies numbered 52, and five fresh urban societies were registered. The Registrar reported "There is an active demand for more societies and for admission to membership of the existing societies." In the same report the Registrar wrote "The capitalist understands as little as the ryot the co-operative aims; as soon as it appears to him that the remedy that is being injected into the body politic is not a sterile vaccine, but contains the germs of a new life that is likely to permeate the entire rural community, the real attitude of the money-lender will be disclosed."

In this year the institution known as the "Central Bank" made a first appearance in these Provinces. A "central bank" is not only a society of organizers and missionaries but it is the distributary by means of which the rivulets of banking—the small societies of borrowers—can be fed from the stream of the money market. The

share capital of the "central bank" provides earnest money and inspires efficiency and vitality. The directors and shareholders are local men and operations are restricted to a tahsil or to a district. At the close of this year there were registered 63 rural societies with a capital of Rs. 31,061 and 2154 members, and 4 urban societies with a capital of Rs. 28,509 and 667 members. One central bank commenced work on a small scale.

4. In 1906 the Registrar had voiced the doubt existing in the minds of many as to the ability of co-operative credit societies to weather the storm of seasonal calamity and crop failure. His utterances were almost prophetic. For the rains of 1907 terminated abruptly and scarcity was prevalent. It must suffice to state briefly that the societies emerged from the ordeal with a degree of success that created much surprise. Recoveries were good; there were no bad debts; and though some renewals were granted nothing occurred to disturb progress. At the close of the year there were 4 central banks, 7 urban and 69 rural societies. Co-operative working capital reached the sum of Rs. 1,61,605.

5. In 1908 the Registrar could write:—"There can be no doubt now that co-operative credit will flourish in the country." Capital increased to Rs. 2,03,601; although only 18 new societies, one new central bank, and one new urban bank were registered. It had been proved, by this time, that co-operative credit provides a genuine field for safe investment.

6. In 1909, 52 new rural societies were registered. The Registrar reported "No fresh ground has been broken; and the increase in the number of societies, as well as their work, must be regarded as spontaneous. This remark does not imply that the work of organizers, both official and non-official has been less strenuous;

they have worked even harder than before ; but in place of a new exotic plant of unknown strength they have now a vigorous growth that requires training in every direction, and occasional pruning." Capital increased to Rs. 2,92,100. "The past year" wrote the Chief Commissioner "has witnessed an important advance. The Sihora Central Bank has shown that well managed societies may expect valuable support from the Joint Stock Banks and has further justified the claim of the District or Tahsil Bank to a place in the co-operative organization by its work in investigating applications of rural societies for registration. A financing society, working in a limited area, is exceptionally qualified to decide on the fitness and reliability of a borrowing society ; the sum of the local knowledge and influence possessed by its directorate is very large and its own interests demand caution and a close adherence to the accepted principles of co-operative banking in the foundation of its client societies. The Chief Commissioner sees in this development a very important practical contribution to the vexed question of organization."

7. In 1910 the movement spread steadily ; and at the close of the year there were 280 rural societies with 7622 members, 8 urban societies with 1247 members, and 12 central banks with 804 members. Capital reached the sum of Rs. 5,02,080. Recoveries were excellent, bad debts practically unknown.

8. We thus come to the present year 1911. When the time arrives to sum up the year's record it will be found that rural societies number about 500, that several new central banks have been formed, that industrial societies have commenced work, that a great advance has been made in the case of existing urban societies, that co-operative capital has again increased very largely, that our list of workers

is longer, and that the question of resources has been solved by the formation of the Provincial Co-operative Bank with a capital of Rs. 5,00,000 which has already been over-subscribed by the leading men of the Provinces. Our policy has been a cautious one; and it will remain cautious. We recognize, readily enough, that we are, as yet, only touching the fringe of our task, and that the road to be traversed stretches away before us into the distant future. And nobody can tell what the years may bring forth,—not even our friends the sceptics.

THE INFLUENCE OF SCIENCE ON INDUSTRY AND COMMERCE.

BY C. GOPAL MENON, F. I. P. S., F. C. I., A. I. B.

The work of practical Science has been to bring about a closer blending of Science with manufactures and commerce. The wonderful growth of modern Science that has taken place had a wonderful effect on industry and commerce. The achievements of Science have been so great that it has entered into every field of nature and thought and have rendered revolutionary changes in no small degree. Applied Science aided by intellectual activity, has wrought wonders and can be best appreciated by an occasional comparison with former times. History abounds with marvels wrought by Science on behalf of commerce and as a result there has been a rapid improvement in the supply of material wants; an increase in enjoyment and happiness; a multiplication of want and desires, with the ability to satisfy them. Our age has been an age of great discoveries in Science and Art. An eminent writer observes;—" Science teaches us the simplest means of obtaining the greatest effect with the smallest expenditure of power, and with given means to produce a maximum of force. "The unprofitable exertion of power, the waste of force in agriculture, in other branches of industry, or in social economy, is characteristic of the want of true civilisation.

" No living being is entitled to claim perfection for the arts useful to man. They are progressive in their very nature; and often when they are thought to be carried to the very highest point of excellence an unexpected discovery opens to them a new career."

The service which Science is continually rendering to industry and commerce is the discovery of natural substances and Dr. Yeats in his work on "The Natural History of Commerce" points out that "without a considerable knowledge of raw materials and of their adaptation, we could not live; and without an unremitting application of such knowledge we could not live in comfort. We may even measure a country's civilization by the extent and diffusion of this important knowledge. The economic history of a nation would be a record of the discovery of new raw materials, of new sources of supply, and of additional applications. All such discoveries tend to our benefit, while their result is occasionally to enrich the discoverer, and to change the face of our social and industrial life."

The object of Science is the discovery of truth. In countries where industrial development is at a low ebb, the problem of the utilization of their resources is the essential theme for consideration. Ample opportunities exist in those countries for the adaptation of Science to practical requirements. It would be hardly possible to enumerate all the benefits which Science has rendered to Industry and Commerce, but the difference which results from the advance of commerce aided by Science can very well be marked out by going into the progress of Science in the nineteenth century. The general condition of the world has been entirely changed since the year 1800. Science, to the thoughtful mind, has given beautiful results, has been pregnant with progressive discoveries besides exercising its greatest influence upon civilization and commerce and upon our every day's comforts. In the earlier decades of the 19th century there were no Railways in operation and no Telegraphic

wires were laid out ; but with that great transition brought about at the close of the 18th and the beginning of the 19th centuries by discoveries and inventions, a change in human affairs took place.

There was great material change affording greater comforts to human being ; the social condition of the world had also been altered. With these every year more railways, roads, ships and steamboats were added, enabling raw materials to be taken from one end to the other. Submarine cables for instantaneous communication at great expense were also laid, Postal and Money order-system and such other things calculated to extend commerce were also introduced. All these marvels were achieved in the short space of fifty years and who knows what would be the wonderful transformation that would take place in the future.

In the middle of the 19th century steam displaced the sailing opium-clippers, once the pride of Calcutta, and gradually outstripped the smart full-rigged ships, which played an important part on the coastal communication of India. The modern steam communication has been so much advanced that its course of voyage could be looked upon with certainty. The Mail boats from England, which used to take two and three months to arrive in India, now takes only a fortnight. Electricity has made a thousand miles as a hair's breadth. Geography, Archæology, Astronomy, Chemistry, Mechanical Science have rendered their help to industry in bringing about its marvellous development in modern times. The greatest service which Science is, therefore, rendering to industrialism is the discovery of natural substances, mineral, vegetable and animal kingdom. Science also helps us to discover a soil more or less fertile. The obligation of commerce to Science is inestimable, as for instance without the help of geology, we are unable to go nearer the centre of the earth in search of coal ; without the aid of Chemistry it is impossible to shape this raw material into proper form. Then again mineralogy selects iron ore for us, and chemistry

converts them into steel, and applied science and mechanics converts the iron and steel into the form of manufactured metals.

Again take the case of the vegetable kingdom ; without Botany we are unable to find the use of a wild fruit or currant and Physiological Botany then helps us to preserve that into a sweet grape. Zoology helps us to find out the natural history of the animal kingdom. With the help of Zoology we are enabled to nurse a caterpillar into a silkworm and afterwards with the aid of Chemistry to bleach and dye the silk which the caterpillar spins. It is then the province of mechanics to weave this silk into a finished article as velvet or into any other form of silk cloth.

Great is the field for investigation and research, and splendid the opportunity for manufacturing industry and skill that are opened out for the industrial and commercial world with the help of Science. Greater are the opportunities and possibilities opened out for the new class of merchants since the introduction of the telegraph, the telephone and the railway. The age of telegraphs, the railway and steam has now given place to the age of Roentgen rays, wireless telegraphy and aeroplane. It is worth noticing that with the help of these agencies a new horizon has been opened out to the mercantile world. Information as to the condition and prospect of a particular crop in any market, and the state of the foreign market in that commodity as well as the rise and fall of exchange, freight etc., had come to be known to all ; and the small capitalist by sheer ability, pluck, industry and courage was able to turn over his capital more rapidly and with comparative safety, owing to the breaking down of the barriers of time and distance. These factors have made commerce to be looked upon from many standpoints. How industrial conditions have been changed by the invention and extension of railways, the growth of steam navigation, the introduction of the factory system and other similar changes tending to a better division of labour and a better and

cheaper distribution of the products of labour and which of these had a greater effect on our trade should be theme for our earnest consideration.

I shall enumerate a few instances of the work Practical Science aided by intellectual enquiry has wrought and its wonderful results. The work of Scientific research in the service of commerce has been carried on in England by the establishment of the Society of Arts, the Imperial Institute and such other offshoots of the Royal Society.

Some of the most important applications of science to commerce began by accident, and were initiated by men with nothing more than common sense. Several instances of this kind can be mentioned as having taken place in England at the beginning of the 19th Century, A few band of young men who laboured merely in quest of their daily bread, fed and clothed multitudes with the results of their inventions. Although England cannot claim a Columbus or Magellan, the names of Kay, Hargreaves, Arkwright, Crompton, Cartwright, Watt, Boulton, Horrocks, Roberts, Bullough, Smeaton, Stephenson, Brindley and others are well known as masters over nature's forces. In a study of the manufacturing and industrial activities, Britain claims more attention than any other nation of the world, for here is the seat and throne of manufactures. That greatness is accountable by the steam engine of Watt, the steamship of Symington and the locomotive of Stephenson. These are the great triads which have built up the modern material world. The age of Geographical discovery paved the way for the age of invention and expansion, and England's success in trade and industry became an accomplished fact. England also attained great success in her naval supremacy ; English shipping opened up new markets and an unlimited supply of her manufactures was thrown upon the foreign markets. Owing to England's greatness in manufactures and commerce, her profits began to increase enormously, which obtained for her financial and economic supremacy. Added, to this the inventions of Arkwright, Hargreaves and Cartwright brought about economic

shipping and weaving of textiles ; those of Nelson and Cost, cheap iron ; those of Bessemer, Siemens, Martin and Thomas, cheap steel. With the advent of this industrial period and growth of population, Britain produced more iron and steel, manufactured more machinery, mined more coal, wove more cloth, than all the rest of the countries in the world.

The value of Science to industry may again be illustrated by looking into the progress of pottery trade in England. We are told that vessels made of clay have been in use among the oldest nations of the earth—Babylonians, Egyptians and Etruscans—excelled in the manufacture of earthenware, but all these were of a rude form. In Europe, no scientific advance in pot-making was made until Europeans began intercourse with the Far East. Vast improvements were made in the pottery trade by the enterprise of the early traders, who when they returned from the Far East, brought home the porcelain of China which they cleverly imitated. It took several years, however, for the continental potters particularly in Sevres and Dresden to study the white enamelling, which is known as "China." The method of manufacturing improved pottery was introduced into England in the Sixteenth and Seventeenth Centuries by the Dutch immigrants. Some of them set up their factory near Burslem, and managed to produce pottery, much superior to any then known in Staffordshire.

Another application of Science to industry is effectively seen in the manufacture of glass. The purposes for which glass is used are very numerous. The principal kinds imported into this country are window glass, coloured glass, glass files and slates, bottle glass, and glass blown pipes. Total imports to India of Earthenware and glass for the ten months ending October 1911 is about ₹ 3,300,251.

India was once considered to be reputed for her industrial greatness and the people were considered as skilled workers in pottery and glass. Whether this is true or not, it is difficult to say after such lapse of time, but we know that in every village in India, there can be seen a potter, who supplies

to the people in the neighbourhood with cooking utensils, water-vessels, goblets, and bowls, &c. There is no doubt that there are ample opportunities for the manufacture of glass in India as may be seen from what Dr. George Watt says that "India abounds in materials which readily yield these necessary constituents. Perhaps the simplest of these is *reh* which contains soda in the form of a Carbonate and a large quantity of silica ready mixed." It is interesting to note that attempts are being made in India for the manufacture of glass on the modern system but these attempts have been far from satisfactory. We trust that the few glass works started in India would soon be able to overcome difficulties and meet with complete success.

Other great manufactures coming under the heading of "Mines and Metallurgy," show more strikingly the trade value of Science, and its wonderful development in modern times. These industries have been revolutionised by Scientific improvements in Machinery, and the improved construction of machinery has been devised to adapt to the Scientific process of extracting these minerals.

Great Britain, the nation of metallic industry, *par excellence*, plays a significant part in the export of coal, the most important of all fuels. Coal is found in most parts of the world, but the chief working of the mines is in England. The export trade in England has increased with amazing rapidity and it is estimated that coal exists in sufficient supply to meet all ordinary demands for the next 200 years. There are many coal beds in India, but only a few of them have been worked so far.

Another most important of all minerals, which enters into such general use and in which scientific manufacture had been greatly developed is Iron. It may be ranked as almost a necessary of life and iron trade deserves pre-eminence in a consideration of industrial arts. Iron occurs in one form or another in every part of the globe and there are regions where it yields in vast quantities. The variety and use of iron are so many that it is hardly possible to enter into the

subject in detail here. The world's annual production of the mineral is estimated at about 60 million tons; two thirds of which is produced in about equal quantities by the United Kingdom, the United States, and Germany. The uses to which iron is put in various manufactures are too numerous. One of the great features of the present age is the triumph of practical science and the manufacture of matter for the service of man. Iron is made to suit the necessities of man more than any other metal by the skill of practised workmen. For this purpose one species of machinery after another has been invented and it has taken years together to attain perfection in machinery manufacture for this purpose. It is not possible here to narrate the stages through which iron industry has passed. Blowing-Apparatus beginning with Smeaton down to Cort's furnaces brought to perfection in 1860, produced more iron than any other previous inventions. Among the later improvements in the manufacture of iron, Mr. Neilson's, hot blast process has attained complete success. Volumes would be needed to narrate the application of Science in this industry. It is only possible to mention here that from railways and steamships down to the cheap hardware manufacture, such as watches, spoons, steel pens, brass pins, locks, &c., each has its own history, illustrating the application of science to trade.

I would, however, add an extract of an article published in the *Mining Journal*, October 2, 1861, giving some incidental notice of the iron ores in many parts of British India. The writer says: "At the different local Exhibitions at Madras, iron from various parts of Southern India was shown. Thus iron ores exist and are worked in the native forges of Masulipatam; iron sand is met with in the beds of rivers and gullies in Mysore, and native iron and iron ores are also found; there are iron ores in Pondicherry, from which pig iron and rails are made; iron ores and metallic iron were shown from Madura by the Rajah of Poodoocottah; and iron stone was sent from Goondalapully and Toomaragod, in Guntoor; iron ore is found in many districts of Travancore, but only in that

of Shencottah is there any extensive smelting conducted. About 250 tons of iron bloom is annually manufactured in the several districts of Travancore. This manufacture, if scientifically conducted and properly managed, could, it is stated, be improved so as to meet the wants of the country. This is not the case at present, for a better and cheaper article is imported. At the Paris Exhibition iron ores from various parts of India, from Chota-Nagpore, and from the Himalayas, and Wootz steel from different localities were shown." It should surely be possible to develop the manufacture of iron even more largely with the undoubted facilities we have for it.

The above extract is enough to show that iron industry in India had once attained its highest excellence and as a proof of the superiority of the Indian wootz (steel), it had been used for the manufacture of Damascus blades. The Indian steel was once sought after for the manufacture of cutlery and was pronounced by Sheffield merchants to be superior to any produced in England. One drawback, however attended metal industry in India, *viz.*, the insufficiency of fuel supply. Charcoal fuel was not so economical for metallurgical industries as ordinary coal. Owing to this defect, some of the iron work companies started in the first quarter of the last century, met with little or no success.

The most important metal wares are those by which the staple textile manufactures have been revolutionized. Cotton trade has been created by them, while the progress in other textiles, woollen, linen and silk manufactures have, by no means, been small. The art of spinning and weaving may be traced back to heroic ages, for mention has been made in the writings of Herodotus to the quality of the cotton fabrics of India. If we take back our researches to the classic authors, we find in the writings of Strabo, Pliny and Marco Poio the progress cotton goods had made in those days. We are not, however, concerned with the narration of the history of cotton as a material for clothing in those historic ages, our business is to trace the subject showing the improvement

that has been made as the outcome of the development of mechanical Science. We have heard so much of our handloom weaving, which had to give way to the far powerful mechanical inventions of the West. The finest Dacca muslins, Cashmere shawls, Bengal Silks and Masulipatam cloths, which were once the pride of Indian workmanship have been lost to the world to-day. The inventions of Kay, Hargreaves, Arkwright Watt and Cartwright have changed not only the method of production, but also given a new shape to industrial activity. The domestic stage of industry became transformed into the factory system, and the centre of economic power shifted from the landed proprietors to the capitalist class. The opening of the Suez Canal in 1869 also altered the channels of commerce and trade and large demands of distant markets were brought so near as to find it necessary to manufacture on a larger scale than ever before. "Factory system," according to Toynbee, "was more due as a system, to the expansion of trade." It is said that the modern industrial revolution commenced in the cotton spinning industry. The utilization of steam power and the scientific application of inventions to methods of production were greater improvements in that line of activity than had ever been made in human history. There was great economy exercised in production. As a result of these factors, England held a pre-eminent position, in the manufacture of cotton goods ever since Indian trade was crippled after the introduction of the European machine made goods. England's principal supply of cotton is from the United States, Brazil and India; Egypt also supplies large quantities. Of Indian production, cotton of Berar is of excellent quality, Madras and Surat are the commonest of all cottons, and are used only for coarse cloths and other articles of great bulk and little value. There are extensive cotton tracts in the valley of the Godavery and are said to be of greater extent than the whole of the American cotton field.

Cotton manufacture at the present day is subjected to the vicissitudes, in the price of the article. Lancashire is still pre-eminently distinguished as the home of the cotton trade,

and exercises a sort of monopoly in the extent of its productive power. In India, Bombay has a number of mills for the manufacture of cotton, and the success attained by these mills has been so far satisfactory.

Woollen and silk manufacture and trade of the world have attained such large proportions that it is impossible to give more than a passing notice here. Next to cotton, it is the most important of all fibres and is utilized for the manufacture of various fabrics. The wool of the alpaca, the Angora goat, the camel and the mohair goat are largely used for the manufacture of woollen goods, but the largest supplies of the substance are obtained from the sheep. Various kinds of wool are obtained from various European countries, Cape Colony, Australia, South America and India—but the greater portion of sheep's wool comes from Australia and South Africa. London is the greatest wool market of the world and the wool imported is again re-exported from London.

The Indian wool is common in quality, and of a coarse and kempy kind obtained chiefly from the sheep in Bengal, Punjab and several parts of the Madras Presidency. In Coimbatore there is a small compact breed of sheep, the animal fattens easily. The wool is thick and curly, and almost free from hair. Wool is also obtained from Khorasan on the hills of Kabool, Ghiznee and various parts of Central Asia.

A few words concerning woollen manufacture. The West Riding of Yorkshire and the west of England are the chief seats of this industry. Leeds is the chief centre of the woollen trade, Huddersfield is for broad cloths and fancy trouserings. Trowbridge manufactures fancy and light cloths of various kinds, and Stroud is noted for scarlet and many other bright-coloured cloths.

The production of silk and its manufacture is mainly carried on the continent, as the climate of England is unsuitable for the cultivation of the silkworm. The chief centres of manufacture in Europe are France, Belgium and Holland.

Italy has long been famous for its silks and Vienna silk manufacture is attracting attention to some extent.

In India Bengal silk is much esteemed and excellent silk is produced in Mysore, but the Mysore silk is almost consumed in the State for the manufacture of silk shawls. The cultivation of the mulberry has been carried on a large scale in and near Bangalore, Mysore and Seringapatam. Silk worms are common in many parts of Burmah.

A short account of the various textiles in India is given without going into the historical facts showing the existence of cloth manufacture. Those who take an interest in the subject can understand the state of textile manufacturing in early India from the writings of European travellers like Bernier, Gamelli, Careri, and Tavernier. They have described the grand and gorgeous display of the Court dress of the Moghul Emperors. Tavernier says that in his various travels in India he found the woollen carpet industry prosperous at Agra and Fatehpur; Silk at Kossimbazar in Bengal; cotton at Surat, Berhampur and Golconda; Calicut for calicoes; Musilapatam for Chints.

From 1857 onwards commenced the troubles of the Indian handloom weaver owing to the introduction of steam-power and electricity into the industrial world. Since then the Indian textile industry began to decline with the exception of Jute manufacture in Bengal, Cotton weaving in the Bombay Presidency. There are handlooms for silk, cotton and wool even now in existence in several parts of India. Benares and Murshidabad are centres for silk handloom goods. The only means of reviving the textile industries of India is by teaching the younger generation the adoption of modern methods of manufacture, improving the methods of cotton cultivation and organising centres of sheep breeding and introducing improved machinery driven either by steam or electricity into these industries.

Many industries have originated in recent years from forest produce, the most important of which is the collection of materials for paper making. The dyestuffs, colouring and

tanning substances are also obtained from the vegetable kingdom. To particularise and dwell upon these would be impossible beyond mentioning the fact that several of the species for dyes and colours are obtained from the Indian jungles. Great skill in colouring was practised by Indians and taught by them to other nations.

It is interesting to point out that a mill for the manufacture of paper out of bamboo-pulp is now being set up in Burma. At present paper is manufactured in India from grass and the attempt to manufacture out of the bamboo-pulp would be the first of its kind. It is hoped that this will meet with success and would be the precursor of other paper making mills out of bamboo-pulp. There is no doubt that our forests have an abundant supply of bamboo and there would, therefore, be no lack of supply of this material for many years to come.

Till the eighteenth century, not much proficiency was displayed in England in the art of dyeing; but since then marvellous advances have been made. Coal-tar dyes, known as aniline colours, have practically superseded all other dyes chiefly owing to brilliancy and variety in colour and shade. Germany has practically a monopoly in these colours, the annual value of the German production being estimated about five millions sterling, whilst England produces only less than one third of that amount.

Before concluding this paper I would like to bring to your notice the state of the Oil Seeds Industry in India. The area in India under cultivation for oil seeds is about 141,000,000 acres of land. The value of the seeds grown on these lands yield an income to India of about £ 12,000,000. The chief seeds which are exported are linseed, sesame, rape, and mustard seed. Then comes castor seed, poppy seed, and among oil nuts, you find cocoanuts, which are exported partly as copra and partly extracted as coconut oil. India exports seeds every year for not less than Rs. 1,800 lakhs, and the bulk of this is shipped to Europe to be worked up there into oil and cake. It is a matter for serious

consideration for retaining this industry in the country and if adequate steps are taken, an important industry might be created. In Calcutta and Bombay some mills have been started for pressing seeds, but the industry requires greater care and consideration on our part. The question of extracting lubricating oil from rape and castor seeds is worth our attention, as the industry in these is the easiest to be worked up.

It would be quite impossible to bring into this paper all the important industries which could be developed with the aid of Science ; it is not scientific knowledge alone that need be sought after. All great and minor industries, such as soap, candle, paper-mills, tanning and oil presses require a large supply of raw material and this must be provided before any industrial development of the country can be thought of. Extended scientific agriculture, improved machinery, cheaper and improved means of transport are all necessary equipments for industrial development of any country. India has a vast supply of undeveloped resources and we only require the magic touch of science to turn them into wealth. Prof. Arthur G. Green, M. Sc., F. I. C. while speaking at the Indian " Guild of Science and Technology, started last year " observed that the " spread of scientific knowledge amongst " the people and the development of India's natural " resources will do a thousand times more than all political " agitations to improve the lot of the masses, abolish supersti- " tion, counteract disease and prevent famine."

In concluding, I would draw your attention to the formation of the Indian Guild of Science and Technology started in London, the object being " the promotion of the knowledge and application of Pure and Technological Science in India with a view to the improvement of the methods of economic production and the amelioration of the Sanitary condition of the people." The formation of the Guild has been the result of the work of Indian students who have gone out to England to study Science and applied Science with the special purpose of using it for industrial pursuits in India.

If India should ever take a prominent place in Natural Science and of the technology based on it, she must popularise scientific knowledge and begin to manufacture things herself. That we have an attitude for scientific study may be judged from the fact that we have at present a few eminent countrymen of ours whose work has been highly appreciated and valued throughout Europe and America. Let us see as to what are our prospects for the future development of this study. There are at present two excellent Agricultural Colleges established by Government at Coimbatore and Pusa where the study of scientific agriculture can be obtained. Then there is the College of science in Poona, the Tata Research Institute opened at Bangalore, in these two institutions scientific study of a highly advanced kind could be obtained. We have also the Victoria Technical Institute in Bombay where all kinds of technological study in applied science and Industry is imparted. We are thankful to Government for the steps taken in the various directions for the promotion of scientific education calculated to devote technical knowledge of a kind needed for the economic and industrial progress of India. There is, however, the want of a College of Technology for imparting instruction in all branches of mechanical and chemical industries and we trust that the suggestion for the establishment of such a college would be soon carried out. No industrial development can be hoped for without an efficient training in scientific knowledge, as that is the only sure foundation on which the superstructure could be built up. Let us hope, therefore, that more of our young men will be armed with the mechanical knowledge growing out of Watt's Steam-engine and such other achievements of science, which are essential for the industrial and commercial ascendancy of any country.

NOTE ON THE PROSPECTS OF ESTABLISHING MATCH FACTORIES IN SOUTHERN INDIA.

BY RAO SAHIB M. RAMA RAO GARU, ESQ.,

Conservator of Forests, Travancore.

In the Indian Forest Memoirs, Vol. II, Part I, Mr. R. S. Troup, F. C. H., Imperial Forest Economist to the Government of India, has dealt with the subject of the Prospects of the "Match Industry in the Indian Empire," with particulars of proposed Match Factory sites and woods suitable for match manufacture. In this excellent book, which no one interested in Indian industries in general, and in the Match Industry in particular, should fail to peruse, Mr. Troup has pointed out that the value of matches imported into India rose steadily from Rs. 50,61,037 in 1903-04 to Rs. 73,76,836 in 1907-08 exclusive of export duty at 5 per cent, which amounted in the latter year to 3½ lakhs. He reckons the total quantity imported in 1907-08 at 1,18,03,000 gross of filled boxes. Out of the value of imports paid in the latter year, Rs. 14,54,094 went to various parts of the British Empire outside India and the balance of Rs. 59,22,742 to other foreign countries of which Sweden and Japan together received Rs. 32,21,795. The quantity of matches mentioned above does not represent the total consumption of matches in India during 1907-08, as a few Indian Match factories appear to have contributed a small portion of the requirements. Mr. Troup estimates the total quantity manufactured in India at 7,00,000 gross of filled boxes per annum. Considering that India is one of the largest forest-owning countries in the world with a much larger number of woody species of trees than any other country, it is indeed a matter for surprise and humiliation that she should depend upon other countries for her matches paying therefor such a huge amount of money annually.

2. After duly considering the advantages and disadvantages of India as a match manufacturing country, Mr. Troup has come to the conclusion that "the prospects of success in the match industry in India are good, provided the industry be developed on proper lines." In respect of the existing match factories in India of which he has enumerated 8, he considers that most of them might have been more successful than they have been but for the wrong choice of factory sites and the absence of expert advice. He attaches great importance to the choice of a suitable factory site which must be determined among other conditions by (1) a sufficient supply of suitable and inexpensive woods in the green state so as to enable the factory to work all the year round, (2) cheap transport from the forests to the factory and from the factory to the area of consumption and (3) availability of a good supply of water for feeding steam engines, for operatives and for storage of wood in order to maintain a stock of moist wood when extraction from the forests is suspended. Close proximity of the factory to a Railway, a navigable river or other export-line for cheap transport of chemicals and other materials to the factory and of matches to the centres of consumption, is advocated.

3. Mr. Troup says that if India were to manufacture all the matches that she now imports, she would require 56 fairly large match factories each turning out 700 gross of filled match boxes *per diem* and working for 300 days in the year, in addition to the few factories already existing, and if to this is added the increase of consumption that may arise by the increase of population and by a trans-frontier land-trade and maritime export trade which will probably spring up, the ultimate number of match factories, which could be maintained in India, may go up to 70 and more.

4. After indicating at some length the methods of

match manufacture, types of matches, materials required, types of match factories and their sizes, quantity of wood consumed, and staff and labour required in Chapter II, he discusses in Chapter III, the expenses and profits of the match industry, briefly dealing with the price of wood, import prices of matches, their sale prices, Railway freights and working expenses and profits. Under this last head, he estimates the capital, required for a well-situated match factory of a daily capacity of 700 gross of filled boxes and equipped with up-to-date machinery, at Rs. 1,70,000 to 1,80,000 including working capital and puts down the cost of production of the best and most expensive match as now imported at about annas 10 per gross. Assuming that such matches sell at annas 14 per gross—the price now paid for imported matches—he estimates the profit at annas 4 per gross or 40 per cent on the cost of production—this cost including depreciation on machinery at 10 per cent and buildings at 2 per cent, trained Manager's salary at Rs. 600 per month and provision for travelling sales men, office expenses and other charges as well as the price of wood and other materials at the average current rates. Mr. Troup says:—"These figures, however, are based on the assumption that the factory is situated on a site which has been well chosen and is thoroughly favorable in every way, and that a sufficient supply of good white wood is obtainable. But as these two factors can be counted on with certainty only in a limited number of localities, it follows that the probable profit on the cost of production in an average Indian match factory will fall a good deal short of 40 per cent." He continues "The interest on the invested capital should ordinarily be from 16 to 20 per cent per annum, allowing for depreciation of machinery and buildings,

provided the site be well chosen and the concern well managed. In places with exceptional facilities the interest may amount to 25 per cent or over."

5. In Appendix II, Mr. A. Roller's (an expert) estimates for a match factory situated in Northern India equipped with the latest machinery are given with details under I—(1) Materials, (2) Wages for all kinds of labour required, (3) Salaries and Manager and (4) General expenses of daily working, II—Different kinds of machines required with their cost, III—Capital required for the various items, and IV—Statement of gross income, expenditure and net earnings. According to Mr. Roller's estimates, the net annual earnings amount to Rs. 33,700. Mr. Troup appends a note wherein, after indicating possible reduction of cost under certain items and providing 10 per cent for depreciation of machinery and 2 per cent on buildings omitted in Mr. Roller's estimates he arrives at Rs. 27,000 as the net earnings per annum. This works out to 16 per cent on the capital of Rs. 1,70,000.

6. As the rate of profit derivable from a factory depends much upon the cheapness or otherwise of wood, Mr. Troup has worked out a table of profits for a factory of the above description and it shows that with the price of wood at one anna per cubic foot the rate of net earnings will be as high as 25.6 per cent, while increase of every additional anna in the price of wood will reduce the profit by about 2 per cent.

7. It is stated that with cheap machinery, chiefly Japanese, the capital required will be Rs. 75,000, Rs. 45,000 and Rs. 30,000 for a daily capacity of 700, 350 and 200 gross of filled match boxes respectively. Mr. Troup

gives, as an example of the prices of machines on the Japanese plan, the following :—

		Rs.	As.	Ps.
Peeling machine	220 Yen	=	336	14 0
Chopping „	80 do.	=	122	8 0
Filling „	120 do.	=	183	12 0
Filling frames	40 sen each	=	0	10 0
Box and drawer making machines	80 Yen		1225	0 0

He is, however, of opinion that 'the finish of the machines and the out-turn of work is not quite up to the German standard' though 'the machines cost only one third to one quarter of the German machines.' He says that the success of a factory on the Japanese model 'depends to a large extent on the persistent efforts of the manager who works hard along with his workmen'. He continues :—"No doubt much could be done in India with machines on the Japanese plan, particularly in localities where the working of a large factory would be impracticable. Whether the originality on the part of the managers and the energy on the part of the workmen will be found in India in such a degree as to make the industry on the Japanese lines a success, is however a matter of grave doubt. Added to this the fact that Japanese methods are as yet practically untried in India, it is not safe to predict that they will be as successful in India as they have been in Japan. For persons with little capital and with the necessary ability and energy there would however appear to be a very fair opening provided care is taken in the choice of their factory sites and the handling of their machines."

8. Chapter IV of the book deals with woods used in the match industry under the following heads :—

- (1) Nature and treatment of wood used, (2) dimensions of wood employed, (3) woods suitable for matches and match boxes, (4) woods suitable for packing cases,

(5) how to obtain timber, and (6) plantations of match-woods. This chapter and Appendix III, which treats of *Particulars regarding the suitability of Indian woods for match manufacture*, are of as much interest to Forest officers and other owners of forests as to match manufacturers.

9. Mr. Troup says that the best woods for matches are soft, white, even and straight grained. There are many softwoods which are not even grained and are yet quite suitable. Softcoloured woods, though suitable, are not used as they do not fetch good prices chiefly owing to prejudice, which may however disappear in course of time. Green round wood with the bark on is used in the peeling process and where green wood is not always available, woods should be stored in water to minimise discolouration and to keep it soft. Under dimensions of woods employed, logs $3\frac{1}{2}'$ to $8'$ in girth and $1'-8'$ in length are stated to be required, but Mr. Troup says, 'it is not advisable to accept logs less than $4'$ in length.'

10. In Indian Match Factories, the chief Indian woods used are stated to be as follows :—

Botanical name.	Tamil.	Telugu.	Malayalam.	Kanarese.
<i>Boswellia Serrata</i> ...	Vellaikungilium.	Anduga. ...	"	Dhupa
<i>Ailanthus excelsa</i> ...	Perumaram.	Peddamanu.	Perumaram.	Doddamara.
<i>Bombax malabaricum</i> ...	Mul-ilavu.	Buruga. ...	Elavu ...	Buruga
<i>Ruchanania latifolia</i> ...	Sarai. ...	Sarappu.	Munga Pezhu.	Murkali
<i>Cratœva religiosa</i> ...	Mavalingam.	Adivilokki.	Nirmathalom.	Nervala
<i>Garuga pinnata</i> ...	Karuvilangan.	Garugu ...	"	Godda, Hala
<i>Excoecaria Agallocha</i> ...	Thillayamaram.	"	Kadvupal ...	"
<i>Mangifera indica</i> (Sapwood only used)	Ma. ...	Mamidi ...	Mavu. ...	Mavu

11. Mr. Troup sent 70 different kinds of Indian woods to be tested to Mr. A. Roller of Berlin and Mr. G. C. Evans of Calcutta. Only woods of 59 species were tested, the rest having gone bad in transit. Of these 59, only 8 species of woods were pronounced by the above gentlemen to be unsuitable, while the remaining 51 were reported suitable in varying degrees. Detailed information regarding these 51 woods is given in Appendix III of the book.

12. Under 'Plantations for Match woods' very interesting and valuable information is furnished and details of forming a plantation of *Bombax malabaricum* with area to be planted for yield of sufficient wood for working a factory of 700 gross of daily capacity, yield per acre, cost, financial forecast and other useful particulars are given. Mr. Troup takes the exploitable size at 6 girth, exploitable age on a suitable soil at 25 to 30 years, and yield per acre at 4,400 cubic feet. Total cost per acre inclusive of interest at 4 per cent. on the outlay varies from Rs. 10.96 for a plantation of 20 years with cost of formation and early tending at Rs. 5, to Rs. 64.87 for a plantation of 30 years with cost of formation at Rs. 20. Taking the longest rotation of 30 years and heaviest rate of cost of formation at Rs. 20, the cost of producing utilisable wood is worked out to 3 pies per c. ft. The money value of the yield of wood per acre of such a plantation is estimated at Rs. 210 assuming 1 *anna* per cubic foot as the sale price, while with a shorter rotation of 20 years and initial cost of formation at Rs. 5 the value of wood produced is estimated at Rs. 264. Mr. Troup concludes the chapter thus "The above figures demonstrate that the systematic formation of *Simal* (*Bombax malabaricum*) plantation on suitable localities and in proximity of possible match-factory sites is likely to be highly profitable to Government and will be of great benefit to the match industry in India."

13. In Chapter V, the choice of sites for match factories is discussed under the heads (1) Mistakes made in the past (in India), (2) Choice of sites of factories of different types, and (3) Definite sites proposed in different Provinces of India, each Province having been dealt with in a separate Chapter from Chapter VI to XIII. Although the information given in these chapters is of great interest and value, I do not propose to enter into details of them here as that course will be beyond the main object of this note, in which it is proposed to consider the facilities that exist in South India for establishing match-factories.

14. Before proceeding to deal with the main purpose of this note, I may mention that I have given, in the foregoing paragraphs, facts gathered from Mr. Troup's book at such length in the belief that the book itself might not have been perused by all who may be interested in Match Industry in South India, and that, without sufficient information before them, this article may not attract the attention of capitalists who may wish to invest their capital in this industry, which is bound to prove a profitable and successful one in some parts of Southern India.

15. In Chapter XIII, which deals with "Match factory sites in the Madras Presidency" the information furnished under "General considerations" is far from encouraging as all the Conservators are stated to have given it as their opinion that there are few or no chances of establishing match-factories in their Circle successfully except perhaps along the Godaveri river and possibly at Tellicherry and Calicut on the West Coast and Udumalpet in the Coimbatore District but Mr. Lodge, the Conservator of the Southern Circle, considers the last three places as unlikely to be suitable.

16. As regards the match woods available in the

Presidency, a list of 28 species is given, of which the suitability of two for the purpose has not yet been tested.

17. Under the proposed match factory sites, Mr. Troup specifies as possible sites in the Presidency, 4 places in the Ganjam District, 3 in Vizagapatam, 2 in Godavari, 1 in Krishna, 1 in Kurnool, 2 in Malabar and 1 in Coimbatore; but against each of them, except the two in the Godavari District, an unfavourable remark is made either that sufficient and steady supply of wood will not be available, or that the distance from which it has to come is prohibitive-

18. It is somewhat surprising that notwithstanding the richness of tree-species both in variety and abundance all along the Western Ghats, it should be thought that there is no scope for establishing match factories successfully. The forests of the South Canara and Malabar Districts and those of the Cochin and Travancore States abound in numerous woody species of both soft and hard woods, especially the forests of the two Native States. Enormous quantities of soft and hard woods are felled annually in clearing areas for rubber plantations and temporary cultivations and their timber burnt and destroyed for want of a market for them. Both the Native States as well as the two British Districts mentioned above are traversed by the Railway as well as by navigable canals and rivers. Timber can be transported cheaply and quickly from forests traversed by the latter during the rainy season while it can always be transported from forests tapped, by the Railway. I believe it is quite easy to arrange for water-storage of match woods at factory sites where timber is transported by rivers or canals during flood seasons only, as the heavy rainfall on the West Coast always keeps up a plentiful supply of water. Moreover, in the case of the Cochin State, there is a good Tramway or rather a light Railway tapping the forests of the State,

for about 50 miles in the interior, and these forests contain a rich store of soft woods suitable for match manufacture. Then again there is the Western portion of the Mysore State with well wooded forests on the Eastern slopes of the Ghats. The Railway runs up to Shimoga within a radius of 20 miles of which there are good forests with a plentiful supply of soft woods. There are also the Thunga and Bhadra rivers traversing forest areas and navigable for timber rafts and by these waterways plenty of timber could probably be worked down to conveniently situated factories and stored for use. As the demand for soft woods is extremely small, it should be possible for the Forest Department of the Native States and the British Districts to deliver woods suitable for matches at an average price of *four annas* per cubic foot at places suitable for match factories.

19. When there are such facilities for establishing match industry in the western parts of South India, it is difficult to believe that suitable sites for establishing factories on a profitable basis cannot be found. As I am not well acquainted with the forests of the Mysore, South Canara and Malabar Districts except the Wynaad Taluk, and the Cochin State, I cannot suggest any locality in them with the authority of personal knowledge, but I may suggest Nanjangode in the Mysore District which is connected by the Railway with Mysore and Bangalore and with the forests of the Heggadevanketta and Gundlupet Taluks and the Wynaad forests of the Malabar District by Kabbani and Cauvery rivers besides good public roads, Sakkarabyle and Kodihalli and Benkipur in the Shimoga District as possible sites in the Mysore Province. In Cochin, Chalakudi, which is the terminus of the tramway and a Railway station on the Shoranore-Cochin Railway, and Parambikulam, which

is further in the interior forests on the Tramway line ought to prove good and suitable factory sites.

20. In the Travancore State with whose forests I am personally acquainted, the following places appear to me to be the best suited for establishing match factories :—

(1) *Malayattur* about 11 miles from the Angamali Railway station on the Cochin-Shoranore Railway with which it is connected by a good public road. It is situated on the Periyar river which traverses a large area of forests whose timber can be worked down along the river and its tributaries during the rains. An unfailing supply of about 80,000 c. ft. of suitable woods such as *Bombax malabaricum*, *B. insigne*, *Anthocephalus Cadamba*; *Elæocarpus serratus* and *E. tuberculatus*, *Holoptelia integrifolia*, *Gmelina arborea*, *Hymenodictyon excelsum* and numerous other suitable woods can be supplied annually for at least 25 years.

(2) *Adirapalli waterfall* on the Chalakudi river about 10 miles from Malayattur in the interior. Here, there is a waterfall which can be utilised for working a saw mill with timber supplies from both the Travancore and the Cochin forests. More than 80,000 c. ft. of suitable woods can be obtained annually for a number of years.

(3) *Meenmutti* on a public road about $3\frac{1}{2}$ miles from the Thenmalai Railway Station on the Maniyachi-Quilon branch of the South Indian Railway. It is about 136 miles from Tuticorin seaport. There is a waterfall which could be probably utilised for working a saw mill. An unfailing annual supply of, at least, 1,50,000 c. ft. of soft woods suitable for matches and boxes can be obtained from the surrounding forests at an average rate of four annas per c. ft. for at least 15 years. For the first 7 or 8 years, wood can probably be supplied at about 3 annas per c. ft. A perennial river runs by the site with every facility for water

storage of timber. There are exceptional facilities for obtaining wood in a green state all round the year and plantations of suitable woods such as the Bombax can be raised in the neighbourhood, cheaply and rapidly, but there would be no need for artificial plantations as the supply from the natural forests within easy reach of the site will be practically inexhaustible. Almost all the 150 species of timbers noted in the list appended to this note are found in the neighbouring forests, besides numerous other species which are omitted as they are hard woods. This locality is an ideal one for establishing a large match factory owing to its proximity to the Railway and to the Seaport towns of Tuticorin and Quilon.

(4) *Punalur Paper Mills*—about 2 miles from the Punalur Railway Station situated on the Punalur river. Supplies of timber can be rafted to the site by the river from the Shendruni valley forests and also carted from the forests of Pathanapuram. This locality has the advantage of possessing a large amount of spare water-power already conserved for working the Paper mill. The existing turbine is said to develop a maximum of 250 Horse Power hardly a fifth of which is being now utilised for the Paper mill.

21. The foregoing are a few of the localities in Travancore where match factories can be successfully worked. These four sites are specially mentioned here because of their close proximity to perennial rivers, to the Railway, to extensive forests from which an unfailing supply of timber in a green state can be obtained, and to the seaports of Quilon and Tuticorin, which help not only to get in supplies of chemicals, &c., from Europe but also to export matches for maritime trade, while the Railways will facilitate transport of finished matches to various parts of South India. The value of matches imported into the Madras Pre-

sidency rose from Rs. 5,09,330 in 1903-04 to Rs. 9,61,083 in 1907-08 and it is fair to assume that it must have gone up a great deal since the latter year. If a factory of 700 gross daily capacity produces annually matches valued at Rs. 1,57,500 as estimated by Mr. Roller, we require more than the annual outturn of 6 such factories for local consumption alone in the Presidency. If South India, would in addition to her own requirements, take up the supply of matches to neighbouring countries like Burma, which alone imported matches valued at more than Rs. 13,00,000 in 1907-08 and Ceylon, there is scope for successfully working at least *a dozen* factories, each of 700 gross daily capacity.

22. From what has been stated in the preceding three paragraphs it will be seen that facilities exist in the South Canara and Malabar Districts and in three Native States of Mysore, Cochin and Travancore for establishing match industry on a profitable basis. Even if the South Canara and Malabar Districts are excluded as being unsuitable as opened by the Conservator of Forests of the Southern Circle, still the three Native States contain forests large enough to keep up a steady and sufficient supply of suitable woods for at least half a dozen big factories. There need be no doubt whatever as regards the certainty of a steady supply of wood in Travancore and Cochin at rates not exceeding 4 as. per c. ft. for at least 20 years to come from the existing natural forests. Woods required for match industry are generally soft ones which are usually left unfelled in the forests for want of demand, only harder ones for which there is demand being hitherto extracted. It will be seen from the appended list that the latter woods are not included in it although the sapwood of some of them might prove suitable for matches. The Conservators of Forests of these

Native States would, I believe, gladly take up the supply, at a nominal profit, of these soft woods to any one who wants them in order to rid their forests of such species and to replace them by harder and more valuable species.

23. Should the supply of woods from the existing natural forests in the localities indicated run short at a future period, it is quite practicable to raise plantations of suitable woods such as the *Bombax malabaricum*, *Ocotea woderi*, *Sterculias* and other species within easy reach of the proposed factory sites. The forcing tropical climate, the heavy rainfall, and the admirable suitability of soil, and other conditions for the rapid growth of such woods exist along the West Coast, and the cost of such plantations will be comparatively small as pointed out by Mr. Troup.

24. The accompanying list of trees shows their Botanical and Vernacular names, the colour of wood and weight per c.ft. of seasoned wood. Woods which have been already tested and found suitable for match sticks, match boxes and packing cases are indicated by an asterisk. Many of the woods are coloured but the colour may perhaps be removed by boiling and bleaching and the prejudice against them may gradually disappear if the matches made of them are otherwise found good and satisfactory. I propose to send samples of the untested woods to some of the existing Indian factories for testing their suitability for matches and boxes, and hope to publish the results later on.

Besides those noted in the list, there are many other species of soft woods occurring in the forests of the West Coast especially in Travancore and Cochin, but they are omitted to be mentioned as they are found in places far distant from the proposed factory sites and at elevations above 1,000 ft.

Travancore woods suitable for Match-making.

* INDICATES WOODS ALREADY TESTED AND FOUND SUITABLE.

No.	Botanical name.	Vernacular name. M. Malayalam. T. Tamil.	Color of wood.	Weight per C. foot.
1	<i>Dillenia pentagyna</i> ...	Koddapunna M ...	Reddish brown with a tinge of grey.	44
2	<i>Polyalthia fragrans</i> ...	Neddunar M ...	Pale yellow	41
3	Do <i>coffeoides</i> ...	Villa M ...	... ..	..
4	Do <i>cerasoides</i> ...	... ..	Olive-gray	52
5	<i>Mitrephora Heyneana</i> ...	... ..	... ..	..
6	<i>Xylopia parvifolia</i> ...	Santhu M ...	Greyish white	44
7	<i>Bocagea Dalzellii</i> ...	Kanakaitha M ...	Pale yellow	49
8	<i>Crataeva religiosa</i> ...	Nirmathalom M ...	Greyish white	28
9	<i>Hydnocarpus Wightiana</i> ...	Maravetti T ...	Dull greyish white	40
10	<i>Xanthophyllum flavescens</i> ...	Mottal M ...	Yellow tinged with grey	48
11	<i>Garcinia cambogia</i> ...	Kodapuli M ...	Pale grey	47
12	Do <i>ovalifolia</i> ...	Manja Nangu M ...	Yellowish white	62
18	<i>Dipterocarpus Bourdilloni</i> ...	Karanjilli T ...	Reddish brown	42
14	<i>Vateria indica</i> ...	Payin M ...	Sapwood greyish white Heart- wood-pale greyish brown ...	39
*15	<i>Bombax malabaricum</i> ...	Ilavu M ...	Greyish white turning to brown in old trees ...	29
16	Do <i>insigne</i> ...	Kallilavu M ...	White	21

17	<i>Eriodendron anfractuosum</i>	...	Panji	T ...	Yellowish white	...	30
18	<i>Cullenia excelsa</i>	...	Vedapla	T ...	Pale brown turning dark with exposure	...	34
*19	<i>Sterculia urens</i>	...	Thondi	M...	Reddish brown with a lighter colored sapwood	...	42
*20	Do <i>alata</i>	...	Ana thondi	M...	Light yellow	...	41
*21	Do <i>guttata</i>	...	Kithondi	M...	Greyish white	...	22
*22	Do <i>villosa</i>	...	Vakka	M...	...	...	18
25	Do <i>colorata</i>	...	Malamparathi	M...	Grey	...	24
24	<i>Pterospermum reticulatum</i>	...	Malavuram	M...	Reddish brown streaked darker	...	43
25	Do <i>rubiginosum</i>	...	Malamthodali	M...	Brigat pink from light to dark shades	...	50
26	<i>Grewia tiliaefolia</i>	...	Unnam	T...	Sapwood-white, heartwood pale brown	...	46
27	Do <i>laevigata</i>	...	...	...	White	...	36
28	<i>Elaeocarpus serratus</i>	...	Nallakara	M...	Greyish white	...	38
29	Do <i>oblongus</i>	...	Kattakara	M...	White	...	"
30	Do <i>turberculatus</i>	...	Ruthrachom	T...	Sapwood-white, heartwood-brown	...	38
31	<i>Evodia Roxburghiana</i>	...	Kanalei	M...	Greyish white	...	27
32	<i>Zanthoxylum Rhetsa</i>	...	Mullillam	M...	Yellowish grey	...	40
*33	<i>Ailanthus malabarica</i>	...	Mattipal	M...	White	...	23
34	<i>Canarium strictum</i>	...	Thelli	M...	White when fresh cut and turning grey with exposure	...	35
35	<i>Anacolosia densiflora</i>	...	Kalpottan	T...	Greyish pink	...	46
*36	<i>Lophopetalum Wightianum</i>	...	Venkottei	T...	Reddish white	...	30
37	<i>Nephelium Longana</i>	...	Shempuvan	T...	Do brown	...	61
38	Do <i>stipulaceum</i>	...	Pavirimulei	M...	Heartwood bright reddish brown, sapwood whitish	...	56

No.	Botanical name.	Vernacular name. M. Malayalam. T. Tamil.	Color of wood	Weight per C. foot.
39	<i>Harpullia cupanioides</i>	Nei Kottei	White	50
40	<i>Turpinia nepalensis</i>	Kanali	Grey	28
41	<i>Meiosma Wightii</i>	Do	Greyish brown	31
42	<i>Mangifera indica</i>	Mavu	Reddish grey	42
*43	<i>Semecarpus Anacardium</i>	Thenkotta	Pale brownish grey	35
44	Do <i>travancorica</i>	Avukaram	Greyish white	28
45	Do <i>auriculata</i>	Charei	Do.	28
46	<i>Anacardium occidentale</i>	Parangimavu	Pale grey	30
47	<i>Buchanania latifolia</i>	Morala	Do greyish brown	36
48	Do <i>lanceolata</i>	Malamavu	"	"
*49	<i>Odina wodier</i>	Kalasan	Sapwood-white turning to grey, heartwood-bright pinkish brown ...	60
*50	<i>Spondias mangifera</i>	Ambalam	Greyish white	22
51	<i>Erythrina stricta</i>	Murukku	White	16
52	<i>Dalbergia lanceolaria</i>	Erigei	Yellowish white	48
53	<i>Ormosia travancorica</i>	Malamanchadi	White	41
54	<i>Poinciana regia</i>	Malamanchadi	White	28
55	<i>Acrocarpus fraxinifolius</i>	Kurangan	Sapwood white Heartwood light red	39
56	<i>Cassia marginata</i>	Kadakonna	Light brown	44
57	<i>Humboldtia Vahlia</i>	Atta vanji	Do	40

58	<i>Albizzia procera</i>	...	Karinthagara	M...	Sapwood yellowish white Heartwood-dark brown streaked with lighter brown	...	45
59	Do <i>stipulata</i>	...	Pili Vagai	T...	Heartwood-pale brown	...	29
60	<i>Pithecolobium Saman</i>	...	Rain tree (Eng.)	...	Light brown	...	31
61	<i>Carallia lucida</i>	...	Vallabhom	M...	Orange	...	47
62	<i>Blepharistemma corymbosum</i>	...	Nirkurunda	M...	Pale greyish yellow	...	42
63	<i>Terminalia belerica</i>	...	Thanni	M...	Yellowish grey	...	42
64	<i>Barringtonia racemosa</i>	...	Samuthram	T...	White	...	28
65	<i>Careya arborea</i>	...	Perzha	M...	Sapwood-pale. Heartwood-dark reddish brown	...	68
66	<i>Lagerstræmia lanceolata</i>	...	Venthekku	M...	Reddish brown	...	48
67	Do <i>Flos Regincæ</i>	...	Manimaruthu	M...	Shining brownish red	...	41
68	<i>Sonneratia acida</i>	...	Thirala	M...	Grey	...	36
69	<i>Casearia esculenta</i>	...	Panni murunga	M...	Yellowish white	...	56
70	<i>Mastixia pentandra</i>	...	Velladambu	M...	Greyish white	...	28
71	<i>Sarcocephalus missionis</i>	...	Attu vanji	T...	Dark yellow	...	37
*72	<i>Anthocephalus cadamba</i>	...	Attuthekku	M ...	Yellowish white	...	40
73	<i>Adina cardifolia</i>	...	Manjakadambu	M ...	Yellow	...	45
74	<i>Stephegyne parvifolia</i>	...	Nirkadambu	T ...	Light pinkish brown	...	39
75	Do <i>tubulosa</i>	...	Malam thumba	M ...	Pinkish brown	...	56
*76	<i>Hymenodictyon excelsum</i>	...	Itthilei	M ...	White when fresh cut-turning brownish grey	...	28
77	Do <i>obovatum</i>	...	Do	...	Do	...	"
78	<i>Randia Gardneri</i>	...	Padarappan	T ...	Light yellowish brown	...	58
79	<i>Canthium didymum</i>	...	Irambaratham	T ...	Light brown	...	58
80	<i>Vernonia arborea</i>	...	Kadavari	M ...	Do	...	"

No.	Botanical name.	Vernacular name. M. Malayalam. T. Tamil.	Color of wood.	Weight per C. foot.
81	<i>Chrysophyllum Roxburghii</i> ...	Atha M ...	Greyish white ...	lb.
82	<i>Palaquium ellipticum</i> ...	Kattilupey T ...	Sapwood-white. Heartwood- reddish brown ...	36 44
83	<i>Diospyros paniculata</i> ...	Illakatta M ...	White and grey ...	46
84	Do <i>microphylla</i> ...	Thovarakari M ...	Reddish grey ...	49
85	Do <i>Embryopteris</i> ...	Panicha M ...	Grey with dark streaks and a darker irregular patch in the centre ...	46
86	<i>Symplocos macrocarpa</i> ...	Paralei T ...	White ...	31
87	Do <i>spicata</i> ...	Kambli vetti T ...	Do ...	37
88	<i>Olea dioica</i> ...	Yedalei T ...	Pale brown ...	49
89	<i>Alstonia scholaris</i> ...	Pala M ...	White ...	27
90	<i>Tabernaemontana Heyneana</i> ...	Do ...	White and pale grey in streaks ...	84
91	<i>Wrightia tinctoria</i> ...	Nilapalai T ...	White ...	49
92	Do. <i>tomentosa</i> ...	Mailam pala M ...	Yellowish white mixed with irregular patches of grey ...	34
93	<i>Ehretia loevis</i> ...	Chavandi M ...	Greyish or brownish white ...	38
94	<i>Stereospermum chelonoides</i> ...	Pombathiri T ...	Greyish brown with patches of brighter brown ...	42
95	<i>Vitex altissima</i> ...	Mayilai M ...	Yellowish brown with a tinge of grey ...	60

96	Do pubescens	...	Attu mayilai	M ...	Reddish brown or olive brown	...	54
*97	Gmelina arborea	...	Kumbil	M ...	Greyish white with a glossy lustre	...	85
98	Myristica magnifica	...	Kothapanu	...	Yellowish white reddening with exposure	...	80
99	Myristica Beddomei	...	Kattu jathikka	M ...	Yellowish brown	...	84
*100	Do malabarica	...	Ponnampanu	M ...	Do. with a grey tinge	...	"
101	Do canarica	...	Undei panu	M ...	Do. grey	...	"
102	Do attenuata	...	Chora panu	M ...	Pale brown	...	85
103	Cryptocarya Wightiana	...	Kadaman pari	M ...	Pale yellowish brown	...	44
104	Beilschmiedia Bourdillonii	...	Morakutti	M ...	Pale brown	...	51
105	Do Wightii	...	Do	...	Greyish white with a wavy grain	...	42
106	Machilus macrantha	...	Kolamavu	T ...	Reddish white darkening to reddish brown with exposure	...	86
107	Cinnamomum zeylanicum	...	Karuva	T ...	Pinkish brown	...	"
108	Actinodaphne Hookeri	...	Mala viranya	M ...	Pale olive prettily streaked and mottled especially in the centre	...	54
109	Do madaraspatana	...	Mungali	M ...	Do	...	"
110	Litsaea sebifera	...	Do	...	Olive grey	...	47
111	Do coriacea	...	Panni thali	T ...	Do	...	"
112	Do zeylanica	...	Molaga shempaga-palai	T ...	Light-brown to yellow	...	"
113	Aporosa Lindleyana	...	Vittil	T ...	Brown	...	88
114	Cyclostemon macrophyllus	...	Mala payini	M ...	Dull greyish yellow	...	55
115	Phyllanthus Emblica	...	Nelli	M ...	Dark red	...	42
116	Mallotus albus	...	Vatta kumbil	M ...	White	...	81
*117	Do philippinensis	...	Manjanathi	T ...	Dull brownish grey or light red	...	44
*117A	(A) Excaecaria Agallocha	...	Komatti	...	Do	...	25

No	Botanical name.	Vernacular name. M. Malayalam. T. Tamil.	Color of wood.	Weight per C. foot.
*118	<i>Trewia nudiflora</i>	Malankumbil	White	29
119	<i>Macaranga Roxburghii</i>	Vattakanni	Pale brown	27
120	<i>Cleidion javanicum</i>	Yellari	Greyish white	"
*121	<i>Holoptelea integrifolia</i>	Aval	Yellowish grey	40
122	<i>Celtis tetrandra</i>	Kuviya	Greyish white	42
123	<i>Trema orientalis</i>	Ami	Reddish grey	30
124	<i>Ficus gibbosa</i>	Ithi	Brownish grey	42
125	Do <i>Dalhousiae</i>	Kal-al	Do	"
126	Do <i>bengalensis</i>	Per-al	Greyish white	36
127	Do <i>mysorensis</i>	Do	Do	"
128	Do <i>tomentosa</i>	Do	White	41
129	Do <i>Beddomei</i>	Thavatta-al	Do	"
130	Do <i>Benjamina</i>	Vel-al	Do	"
131	Do <i>Trimeni</i>	Do	Do	"
132	Do <i>retusa</i>	Kal-athi	Light reddish grey	87
133	<i>Ficus Talboti</i>	Ithi	Very white when fresh cut turning yellow with narrow rings of dark and light tissue alternating	87
184	Do <i>nervosaa</i>	Nir-al	White	"
185	Do <i>religiosn</i>	Arasu	Do	35

186	Do arnotiaa	...	Ama kanniyan	M ...	Do	...	"
187	Do Tjakela	...	Kar-al	M ...	Brown	...	80
188	Do Tsiela	...	Do	M ...	Grey	...	84
189	Do infectoria	...	Cherla	M ...	Greenish grey	...	"
140	Do callosa	...	Koli-al	M ...	White	...	"
141	Do asperrima	...	Theragam	M ...	Greyish white	...	24
142	Do hispida	...	Erumanakku	M ...	Dirty grey	...	80
148	Do glomerata	...	Athi	M ...	Brownish grey	...	"
144	Artocarpus integrifolia	...	Pilavu	M ...	Sapwood-pale Heartwood-some- times mottled, darkening with exposure to orange brown	...	89
145	Do hirsuta	...	Anjili	M ...	Sapwood-white, Heartwood- yellowish brown	...	85
146	Antiaris toxicaria	...	Marauri	T ...	White	...	24
147	Streblus asper	...	Parava	M ...	Do	...	40
148	Cordia Myxa	...	Virasu	T ...	Greyish brown	...	88
149	Do octandra	...	Potta virasu	T ...	Whitish brown darker in the centre	...	21
150	Miliusa velutina	...	Kana kaitha	M ...	Yellow when fresh, light brown when old with a dark purple patch in the centre	...	20

APPENDIX I.

SUGAR INDUSTRY IN INDIA.

Printed letters were issued,—and I received one of them, bearing No. 4198 of 1911, dated 16th November 1911, by Hon'ble Rao Bahadur R. N. Mudholkar, General Secretary, Indian Industrial Conference to the effect, that a special meeting of the Conference would be held this year to discuss only one subject, as on account of the Royal Visit to Calcutta, it would be difficult to devote more than a morning sitting from 10-30 A. M. to 1-30 P. M. It was suggested that the subject for this year should be "the present condition of Sugar Industry in India and the methods for improving it." To this, I replied from Indore on the 19th idem, stating that I highly appreciated the proposal of the General Secretary, and submitted to him my desire to take part in the proceedings; and along with the general question of Sugar development in India, to lay, so far as I and my paper were concerned, special stress on the industry for the production of *Date rab* and Date Sugar from the date trees which exist by millions in the Central Provinces and in Central India, and are altogether unutilized by the people. I stated further that for nearly last fifteen years I have been engaged, first in making experiments on the local date trees in those provinces, and then in demonstrating the supreme benefit which the British and the Indian States could derive by widely introducing the industry within the limits of their territories in the same manner as it prevails in many districts of Bengal. I also said in my reply that I was engaged in the cultivation of cane in some of the villages in the Indore District the soil of which is known to be very rich for the growth of splendid sugar-cane for the production of raw cane sugar alongside with date sugar in those villages.

2. It is now announced that a short sitting of the Industrial Conference will be held here at the Congress Pandal on the 29th instant. For this reason, I have ventured to prepare and to circulate this brief note on the subject in order to show that "the time has now come for making an advance, and to add a new feature to our programme of work," as the Hon'ble Rao Br. Mudholkar has rightly remarked in his letter. Enough of discussions and paper readings have been held, year after year, on this technical line of industry,—Indian sugar production; and about the time that Mr. Mudholkar's letter was being circulated in this country, the Seventh Meeting of the Board of Agriculture was held

at Pusa, where the Conference of distinguished experts of all the Indian Provinces met, day after day to discuss threadbare the *pros* and *cons* of the sugar problem in India. Their proceedings were conducted in a most thorough and practical manner by references of special subjects to Special Committees of experts to invite opinions for the consideration and decision of the Board. The Committee F. was for the Indian Sugar Industry under several sub-heads of the terms of reference. The result was the Reports of the Special Committees in due course upon which full discussions were held and definite Resolutions were arrived at by the Pusa Board of Agriculture. These dispose of everything that we can possibly do in the line of any further discussions or resolutions on the subject. But it is very remarkable, as it is a matter of considerable regret, that neither at the time when the Behar Sugar Commission was held towards the end of the last century, nor at the recent Conference held at Pusa, has any attention been devoted to the development and expansion of the palm sugar in India; and it has now been said that there were not materials enough before the Board to arrive at any definite conclusions regarding the subject. But the information supplied by the Statistics published by Dr. Hunter, by the Dictionary of the Economic Products of India by Sir George Watt published in 1885—1894, and by the latter's Commercial Products of India published in 1908, page 886, where facts and figures have been quoted and references to a mass of highly interesting and useful literature on palm sugar have been made, would appear to contain all that need be known to give a stimulus to this most necessary and important branch of sugar industry in India. It is therefore suggested that what has been left untouched by the Behar Sugar Commission over twelve years ago, what has been referred to but avoided by the Pusa Board of Agriculture, and what has been repeatedly considered at length by the successive Indian Industrial Conferences at Benares, Calcutta and elsewhere, but in respect of which everything has been left undone, namely, the expansion and development of Palm Sugar in the Central Provinces and in Central India should alone engross the sole, close, undivided attention of this year's proposed Industrial Conference in Calcutta.

8. In moving the Fifth Resolution on the Report of the Sugar, F, Special Committee at Pusa, Dr. Leather is reported to have said that the Board accepts the Committee's view that the investigation of the Palm Sugar industry is desirable from the chemical and agricultural points of view; but that the industry though not small might be extinguished owing to the ease of making the juice into spirit. The process of manufacture, it was said, was different from that in the case of cane sugar, and deserved investigation. A little fur-

ther study and observation would have shown that there was absolutely no chance or risk of extinction of this most valuable industry in this country, and that there were absolute and undoubted possibilities of very quick and extensive development of this industry in many Districts in the Central Provinces, and in all the Territories of the States in Central India. Mr. Arnett, in supporting the Resolution said "that 480,000 out of 3,000,000 tons, or 17 P. C. of India's production of Sugar was Palm Sugar. The industry was widespread, and the products largely consumed locally. Practically no scientific work had been done hitherto. The yield from one acre had sometime been estimated at nine tons..... The industry was capable of great improvement." The Board and the Committee took into consideration the present figure in acres where sugar-cane is grown in India, and devoted much thought and discussion on the possibilities of further increased cultivating area. The Government publication of the Commercial Products of India by Sir George Watt in 1908, states, from Official figures, that over 1½ lacs of acres are under date palm cultivation in Bengal. At the rate, then, of about 9 tons of raw sugar from one acre of palm cultivation, the produce would be over 18 lacs of tons, and not merely 5 lacs of tons, as Mr. Arnett puts ; otherwise, it must be presumed that there has been considerable shrinkage of palm cultivation in Bengal, unless it be that about 4 to 5 tons represent the outturn of raw palm sugar from one acre of land overgrown with date plants. Be that as it may, we have thousands of acres of forest land in the Central Provinces and in Central India over which stronger and healthier date trees stand ; and yet none has raised his little finger to reduce them to utility. The Government and the people of those provinces did not, before my experiments and demonstrations were made in several parts of the province, know that *goor*, *rab*, or sugar in paying quantities could be abstracted from the date trees. Therefore, even if we take about a couple of lacs of acres of the date forest lands lying idle and unutilized in those provinces, we are wasting the resources of an annual outturn of over one-third, or perhaps full half of nearly 30 lacs of tons of India's total production of sugar! It is for this reason, that we had to hear the indignant remarks of Sir Donald Hamilton at the First Indian Industrial Conference held at Benares on the 30th December 1905. "Take for example," he said, "the date sugar trees which are now running to waste by the millions in Central India. There you have the raw material of genuine swadeshi sugar to be had for the lifting ; and yet none of the leaders of the people appear to be sufficiently interested in their poor countrymen to show them how to tap the date trees. I am safe in saying that in no other country would resources of this nature be left lying unused as they are

in India. If the men who are so fond of talking about the bread problem would respond to the cry of their country for food with something more satisfying than eloquence, India would be further ahead than she is to-day." It has been ascertained that the annual yield of raw sugar from one average date tree represents the outturn from more than 100 first class cane that can be anywhere grown in India. At my instance, the Political Agency Authorities in Central India were pleased to direct a counting of the date trees in a small Minor State, Bagli, in Central India. There are 70 villages containing about 1½ lacs of date trees, capable to yield raw sugar worth about 1½ lacs of rupees a year. The annual revenue of the State is said to be much below one lac of rupees. The other Central Indian States of Indore, Gwalior, Bhopal, Dhar, Dewas, &c., represent in this respect several multiples of date palm forests that are lying idle and unutilized.

4. Next and finally, the practical question arises,—how to attack such a large area of the country, and to avoid the most serious annual losses? The answer to this is to be found in the concluding and the Eighth Resolution of the Pusa Board, namely, "The Board recommends that the Local Governments should be empowered to assist pioneer factories by subsidy, by taking deferred shares, or by such other methods as may be appropriate." I am not called upon to state in what manner should the subsidies or the bounties be distributed. But there can be no manner of doubt that organizations in the form of importing and settling tappers-agriculturists in C. P. and in C. I. in agriculture, cultivation and production of sugar are indispensable to establish and to expand the industry on its national lines in the same way as it is widely prevalent in Bengal.

5. It remains now for me to APPEAL to the Hon'ble Mr. M.B. Dadabhoi, the President elect, and to the Hon'ble Rao Bahadur R.N. Mudholkar, the General Secretary of the Indian Industrial Conference, both leading members of the C. P. Bar, and Hon'ble Members of the Imperial Legislative Council, to consider the great possibilities of sugar industry from Cane as well as Date that exist in the Central Provinces and in Central India. The matter stated above is practically a provincial question for them and our humble selves immediately to attend to and to exert for the initiation and development of the projected industry in our own provinces.

CALCUTTA,
The 28th December 1911.

} HARI DAS CHATTERJEE, M.A., B.L.,
Pleader
Khandwa, C.P. : Indore, C. I.

APPENDIX II.

RESOLUTIONS PASSED AT THE FIRST INDIAN INDUSTRIAL CONFERENCE.

Held at Benares on the 30th December, 1906.

Resolved that this Conference urges the Government of India and all Provincial Governments and administrations, as also the people of India according to their powers and opportunities,—

- (1) To found Technical Schools in all large centres for the Industrial education, on an adequate scale, of the Indian people,
- (2) To encourage and help Indian manufactures,
- (3) And to foster and extend the use of such manufactures in India in preference to foreign goods.

Proposed by the Honourable Munshi Madho Lal (Benares).

Seconded by Mr. A. Chowdhri (Calcutta).

Supported by Mr. N. Subba Rao (Rajahmundry).

II

Resolved that this Conference urges all Provincial Government and administrations as well as the proprietors and managers of private schools and colleges to add commercial classes, and industrial classes like those of weaving, dyeing, carpentry, &c., to the existing educational institutions where practicable.

Proposed by Mr. G. Subramania Iyer (Madras).

Seconded by Mr. Ali Mahomed Bhimji (Bombay).

III

Resolved that this Conference specially invites the attention of Indian capitalists to the great importance of introducing the use of improved hand-loom among the weavers of India, and recommends the establishment of weaving schools, where boys may learn the use of such looms, with a view to their more extended use among the towns and villages of all Provinces in India.

Proposed by Mr. Prabhas C. Mitra (Calcutta).

Seconded by Mr. Babulal Govika (Aligarh).

Supported by Mr. Fazlal Hassain (Aligarh).

IV

Resolved that this Conference urges Indian capitalists to establish at their own cost schools for spinning, dyeing, pottery, carpentry, and

the manufacture of ironware and brassware, in order to afford facilities to boys of all castes and classes to learn such useful industries as a means of their livelihood.

Proposed by Rai Bahadur Lala Baij Nath (Allahabad).

Seconded by Pandit Rambhaji Dutt Chowdhri (Lahore).

Supported by Mr. L. R. Das (Calcutta).

v

Resolved that where it is possible to raise large funds for Industrial education, this Conference recommends the placing of such funds in the hands of trustees with a view to the establishment of Technological Colleges on the most modern methods adopted in Europe, America and Japan for the training of large numbers of students in the various industries which are profitable in India.

Proposed by Sir Bhalchandra Krishna, *Kt.* (Bombay).

Seconded by Rai Saheb Lala Girdhari Lal (Delhi).

Supported by Mr. Lakhbir Singh (Muzaffarnagar).

VI

Resolved that Provincial Committees be established in Bengal, Bombay, Madras, the United Provinces, the Punjab, and the Central Provinces and Berar consisting of the members named below for giving effect to the above recommendations, generally encouraging industries and making an industrial survey in their several provinces and compiling useful facts and suggestions for submission to the next Industrial Conference in December 1906. In order to carry out these views each Committee is requested to raise suitable funds, appoint trustees, frame rules for the conduct of business and lay their accounts before the next Industrial Conference.

Resolved that the following gentlemen be the members of the Provincial Committees for the year 1906, with power to add to their number :—

BENGAL.

T. Palit, Esq.

The Honourable Mr. J. Chawdhari.

R. N. Mookerji, Esq.

BOMBAY.

D. E. Wacha, Esq.

The Honourable Mr. Vithaldas D. Thackersey.

Lalubhai Samaldas, Esq.

MADRAS.

N. Subba Rao, Esq.

The Honourable Mr. L. A. Govindaraghava Iyer.

V. Krishnaswami Iyer, Esq.

UNITED PROVINCES.

Rai Bahadur Lala Baij Nath.
The Honourable Pandit Madan Mohan Malaviya.
Munshi Ganga Prasad Varma.

THE PUNJAB.

Rai Bahadur Lala Ganga Ram, C. I. E.
Shaikh Umar Baksh,
Lala Harkishenlal.
Lala Lajpat Rai.
Lala Mulkaraj.

CENTRAL PROVINCES AND BERAR.

Rao Bahadur R. N. Mudholkar,
G. S. Khaparde, Esq.
M. V. Joshj, Esq.

Proposed by Lala Lajpat Rai (Lahore).

Seconded by Rai Bahadur Ganga Ram (Lahore).

Supported by the Honourable Mr. L. A. Govindaraghava Iyer
(Madras).

VII

Resolved that this Conference appoints Rao Bahadur R. N. Mudholkar as General Secretary, empowers the President to appoint a permanent Assistant Secretary and establishment on suitable pay and allots a sum of Rs. 5,000 for meeting the expenses of the next twelve months.

Proposed by the Honourable Pandit Madan Mohan Malaviya (Allahabad).

Seconded by Mr. C. Vijayaraghavachariar (Salem).

BENARES,
The 30th December, 1905.

R. C. DUTT,
President.
R. N. MUDHOLKAR,
General Secretary.

RESOLUTIONS PASSED AT THE SECOND INDIAN INDUSTRIAL CONFERENCE.

Held at Calcutta on the 29th and 31st December, 1906.

1. TECHNICAL AND COMMERCIAL EDUCATION.

RESOLVED—That this Conference re-affirms the Resolution passed at the Conference of last year on the subject of Technical and Commercial Education, and requests the Government to establish a sufficient number of Secondary Technical and Commercial Schools, a superior Technical College for each Province, and one fully equipped first class College of Technology for all India. And that a Committee consisting of the President, the General Secretary, Messrs. R. C. Dutt, D. E,

British India and the Governments of other Indian States to carry out at an early date Industrial Surveys of the territories within their jurisdiction as exact and detailed information would afford facilities for the introduction of a sound system of technical education and the well-ordered development of indigenous industries.

(Proposed by Sir Bhalchandra Krishna, *Kt.*, of Bombay, seconded by K. Natarajan, Esq., of Bombay, and carried unanimously.)

II. TECHNICAL AND COMMERCIAL EDUCATION.

RESOLVED—(a) That this Conference re-affirms the Resolution on Technical and Commercial Education passed at the last Conference.

(b) That this Conference thanks the Government of the United Provinces for the action taken by them with a view to introduce a fairly comprehensive system of Technical Education in those Provinces and would express the hope that other Provincial Governments will be pleased to convene representative conferences such as the recent Naini Tal Conference to devise measures for the spread of Technical Education in their respective provinces. And this Conference further expresses the hope that the Government of India would provide adequate funds for giving effect to the recommendations of the Naini Tal Conference and carrying out similar schemes in other provinces.

(c) That this Conference, while appreciating the action taken by the Governments of some Indian States to encourage Technical Education, urges that further steps should be taken in the same direction in all Indian States.

(d) That this Conference welcomes the growth of public interest in Technical Education as shown by the action taken by certain local and municipal boards and private associations in promoting it, and it strongly urges on the leaders of the people the necessity of taking practical steps for providing increased facilities for it by starting institutions and founding scholarships to encourage technical studies in India and abroad.

(Proposed by R. C. Whitenack, Esq., of Baroda, seconded by D. G. Dalvi, Esq., of Bombay, supported by Ishwar Das Varshini, Esq., of Aligarh and Professor Ruchi Ram Sahni of Lahore, and carried unanimously.)

III. AGRICULTURAL EDUCATION.

RESOLVED—That this Conference records its sense of appreciation of the action taken and contemplated by the Government in regard to the establishment of Agricultural Colleges in the several provinces, and would urge that in view of the importance of a wider spread among the cultivating and landholding classes of a practical knowledge of the

principles of scientific agriculture and modern methods, Government would be pleased to establish Experimental and Demonstration Farms as widely as possible, and to start vernacular schools in connection with them one at least in every district.

(Proposed by G. Subramania Iyer, Esq., of Madras, seconded by Rao Bahadur Khandubhai Gulabbhai Desai of Surat, and carried unanimously.)

IV. AGRICULTURAL BANKS.

RESOLVED—That this Conference begs to call the attention of Government to the urgent need of promoting the establishment of Agricultural Banks to help co-operative credit societies and to advance loans directly to agriculturists at reasonable rates of interest, and further begs to suggest that the advice and co-operation of representative members of the Indian community may be enlisted in devising a suitable scheme to secure this object.

(Proposed by Rao Bahadur Lalshankar Umaishankar of Ahmedabad, seconded by Thakorram Kapilram, Esq., of Surat, and carried unanimously.)

V. THE MINING INDUSTRY.

RESOLVED—(a) That this Conference expresses its sense of satisfaction at the successful formation of the Tata Iron and Steel Company Limited, with the help entirely of capital raised in India.

(b) That this Conference invites the attention of capitalists in India to the urgent need of developing and fully utilising the mineral resources of the country and trusts that in view of the ultimately lucrative character of the industry they will make organised efforts in that direction.

(c) That this Conference is of opinion that special consideration should be shown to Indian enterprise and initiation by the Government and preferential treatment given to it.

(Proposed by Rao Bahadur R. N. Mudholkar of Amraoti, seconded by the Honourable Mr. Gokuldas K. Parekh of Bombay, and carried unanimously.)

VI. COTTON SPINNING AND WEAVING.

RESOLVED—(a) That this Conference records its sense of satisfaction at the stimulus the Spinning and Weaving industries have received from the Swadesi movement and it urges the bestowal of increased attention on cotton cultivation, the erection of Spinning and Weaving Mills at suitable centres, and the revival of the Hand-loom Weaving Industry on a commercial basis, as essential to the success of the movement.

(b) That this Conference urges the Government to remove the restrictions retarding the expansion of the industry and to provide facilities for affording practical instruction in weaving by the establishment of Weaving Schools at every important weaving centre.

(Proposed by L. K. Tulasiram, Esq., of Madura, seconded by S. B. Sankaram, Esq., of Ellore, and carried unanimously.)

VII. THE SUGAR INDUSTRY.

RESOLVED—(a) That this Conference notices with concern the increase in the imports of foreign sugar, and is of opinion that to arrest the steady decline of the indigenous industry, it is absolutely necessary to encourage the cultivation of healthier and more prolific varieties of cane, to employ greater care in cultivation, to use more economical processes for extracting the juice, and, above all, to adopt the most modern and efficient methods of refining.

(b) That this Conference urges the Government to provide more extensive irrigational facilities, to allow the utilisation of bye-products and, further, to consider the desirability of imposing a duty upon imported sugar in order to protect the indigenous industry.

(Proposed by the Honourable Pandit Madan Mohan Malaviya, of Allahabad, seconded by Manubhai Nandshankar, Esq., of Baroda, supported by Lala Dharamdas Suri of Lahore and Chunilal Vrijbhukandas, Esq., of Bombay, and carried unanimously.)

VIII. APPOINTMENT OF OFFICER-BEARERS AND PROVISION OF FUNDS FOR THE YEAR 1908.

RESOLVED—That this Conference re-appoints Rao Bahadur R. N. Mudholkar as General Secretary and Mr. C. Y. Chintamani as Assistant Secretary, and it appeals to the public for a sum of Rs. 10,000 for meeting the expenses for the next twelve months.

(Proposed by Sir Bhalchandra Krishna, Kt., of Bombay, seconded by the Honourable Pandit Madan-Mohan Malaviya of Allahabad, and carried unanimously.)

SURAT,
The 30th December, }
1907.

AMBALAL SAKERLAL DESAI,
President,
R. N. MUDHOLKAR,
General Secretary.

RESOLUTIONS PASSED AT THE FOURTH INDIAN INDUSTRIAL CONFERENCE.

Held at Madras on the 26th and the 27th December 1908.

I. DEPARTMENTS OF INDUSTRY.

RESOLVED—(a) That this Conference is of opinion that there should be in every province of British India a Department of Industry under a

Director of Industries to deal with industrial questions and to be in charge of technical and commercial education as well as industrial instruction ; and that there should be an Advisory Board of qualified persons, not less than one-half of whom should be non-official Indians, who should be consulted on all matters of importance.

(b) that the functions of this Department should include (1) the supply of advice in regard to new industries, (2) the introduction of new or improved methods and processes, (3) the carrying out of investigation and experiments, (4) the development of selected industries, and (5) the organization of industrial and commercial exhibitions ;

(c) that there should be an industrial museum and a bureau of information under the Department of Industry for supply of information to the public on industrial and commercial matters.

[Proposed by D. E. Wacha, Esq., (Bombay), seconded by Rao Bahadur G. Srinivasa Rao (Madura), supported by R. V. Mahajan Esq., (Akola), and carried unanimously.]

II. TECHNICAL AND INDUSTRIAL EDUCATION.

RESOLVED—That this Conference re-affirms the Resolutions of the previous Conferences on Technical and Industrial Education, and urges (1) that the Victoria Jubilee Technical Institute, Bombay, and the College of Science, Poona, be enlarged so that they may between them supply for the Presidency of Bombay technological instruction in all the branches of mechanical and chemical industries ; (2) that the Government of India may sanction the proposal of the Government of Bengal to add classes in industrial Chemistry to the Sidpur Engineering College ; (3) that the Government of Madras will be pleased to give effect to the recommendation of the Ootacamund Industrial Conference that the Madras College of Engineering should be expanded into an Institute of Technology ; (4) that the Secretary of State might accord early sanction to the proposal of the Government of the United Provinces that a College of Technology should be opened at Cawnpore ; and (5) that similar institutions should be established in the Punjab, Burma and Eastern Bengal and Assam.

[Proposed by the Hon'ble Pandit Madan Mohan Malaviya, (Allahabad), seconded by the Hon'ble Mr. Gokuldas K. Parekh (Bombay), supported by T. Rangachariar, Esq. (Madras) and Lalla Dharam Das Suri, (Lahore) and carried unanimously.]

III. COMMERCIAL EDUCATION.

RESOLVED—(a) That in the opinion of this Conference the time has come for the Indian Universities to create Faculties of Commerce and

institute Degrees in Commerce, and to affiliate Commercial Colleges that will prepare candidates for University Degrees in Commerce ;

(b) that there should be established one College of Commerce at each Provincial capital and that it should include provision for the training of teachers for Commercial Schools in the mofussil.

[Proposed by K. Subramani Aiyer, Esq. (Bombay), seconded by D. G. Dalvi, Esq. (Bombay), and carried unanimously.]

IV. AGRICULTURAL BANKS.

RESOLVED—That this Conference again invites the attention of the Supreme and the Provincial Governments to the urgent need for Agricultural Banks both to assist Co-operative Credit Societies and, in cases where Co-operative Credit Societies cannot or will not serve, to advance loans directly to agriculturists on easy terms, and urges them to take early action in the desired direction in conjunction with Indian capitalists who, the Conference feels confident, would be ready to co-operate with Government in any such scheme.

[Proposed by Lalubhai Samalds, Esq., (Bombay), seconded by Rao Bahadur Khandubhai G. Desai (Surat), supported by Rao Bahadur V. K. Ramanujachariar (Kumbakonam), and carried unanimously.]

V. COTTON EXCISE DUTY.

RESOLVED—That this Conference records its emphatic protest against the continuance of the Excise Duty on Indian mill-made cloth as an unjust and unnecessary impost and urges that it should be removed without delay.

[Proposed by Uttamlal K. Trivedi, Esq. (Bombay), seconded by Pandit Rambhuj Dutt Chowdhuri (Lahore) and carried unanimously.]

VI. RAILWAY RATES ON GOODS.

RESOLVED—That this Conference calls the attention of the Government to the prevailing complaints about existing railway rates, and suggests that an enquiry should be instituted into their effect on indigenous industries especially in their competition with imported goods, and further submits that the rates should be reduced where their effect may be proved to be injurious.

[Proposed by Dewan Bahadur Ambalal S. Desai, (Ahmedabad), seconded by Rao Bahadur Doorao Vinayak (Akola), and carried unanimously.]

VII. MINING, WEAVING AND SUGAR INDUSTRIES.

RESOLVED—That while expressing its satisfaction at the steady progress of the Swadeshi movement, this Conference, concurring with

the last Conference, calls the particular attention of capitalists and the general public to the necessity of developing the Mining, Weaving and Sugar industries, and urges the formation of Joint-Stock Companies for working mines and erecting mills and factories.

[Proposed by the Hon'ble Sir Vithaldas D. Thackersey, *Kt.* (Bombay), seconded by G. Subramania Iyer, Esq., (Madras), supported by the Hon'ble Mr. H. S. Dikshit (Bombay), and carried unanimously.]

OFFICE BEARERS AND FUNDS FOR NEXT YEAR.

RESOLVED—That this Conference re-appointed Rao Bahadur R. N. Mudholkar as General Secretary and Mr. C. Y. Chintamani as Assistant Secretary for the year 1909, and appeals to the public for a sum of Rs. 5,000 to meet the expenses for the next twelve months.

[Proposed by N. Subba Rao Pantulu, Esq., (Rajahmundry), seconded by Babu Gunga Prasad Varma (Lucknow), and carried unanimously.]

MADRAS,
The 27th December, 1908. }

R. N. MUDHOLKAR,
President.

RESOLUTIONS OF THE FIFTH INDIAN INDUSTRIAL
CONFERENCE

Held at Lahore on the 30th December 1909.

I. DEATH OF MR. R. C. DUTT.

RESOLVED—That this Conference places on record its profound sorrow for the sad death of its first President, the late Mr. Romesh Chandra Dutt, C. I. E. The Industrial movement has lost in him one of its ablest and most zealous champions, and the country, one of her most accomplished, earnest and patriotic sons. That this Conference authorizes the General Secretary to convey the above Resolution to the widow and son of Mr. Dutt.

II. PURCHASE OF STORES BY GOVERNMENT DEPARTMENTS.

RESOLVED—That this Conference thanks the Secretary of State and the Government of India, for the orders, which have been recently issued in regard to the purchase by Government Departments of articles, made in India, in preference to those of foreign manufacture. The Conference while recognising the fact these orders mark a distinct advance in the policy of Government towards the encouragement of indigenous industries and manufactures is of opinion that the report of the Committee be published for general information and guidance in the future.

III. TECHNICAL AND INDUSTRIAL EDUCATION.

RESOLVED—That this Conference regrets that the proposal of the United Provinces Government for the establishment of a Technological College at Cawnpore, which was supported by the Government of India, has not been sanctioned by the Secretary of State. In view of this fact this Conference re-affirms the Resolutions of the previous Conference on Technical and Industrial Education and again urges :—

(1) that the Victoria Jubilee Technical Institute of Bombay, and the College of Science at Poona, be enlarged so that they may between them supply for the Presidency of Bombay technological instruction in all the branches of mechanical and chemical industries ;

(2) that the Government of India may sanction the proposal of the Government of Bengal to add classes in Industrial Chemistry to the Sibpore Engineering College ;

(3) that the Government of Madras will be pleased to give effect to the recommendation of the Ootacamund Industrial Conference that the Madras College of Engineering should be expanded into an Institute of Technology ;

(4) that the Secretary of State might accord early sanction to the proposal of the Government of the United Provinces that a College of Technology should be opened at Cawnpore ; and

(5) that similar Institutions should be established in the Punjab, Burma, Eastern Bengal and Assam.

IV. COMMERCIAL EDUCATION.

RESOLVED—(a) That in the opinion of this Conference the time has come for the Indian Universities to create Faculties of Commerce and institute degrees in commerce and to affiliate Commercial Colleges that will prepare candidates for University degrees in commerce ;

(b) that there should be established one College of Commerce each provincial capital and that it should include provision for the training of teachers for Commercial Schools in the mofussil.

V. AGRICULTURAL BANKS.

RESOLVED—That the Conference again invites the attention of the Supreme and Provincial Governments to the urgent need of establishing Agricultural Banks for assisting the existing Co-operative Credit Societies and for advancing loans direct to agriculturists, on easy terms wherever such societies do not exist, with the view of ameliorating the economic condition of the Indian peasantry.

VI. COTTON EXCISE DUTY.

RESOLVED—That the Conference records again its emphatic protest against the continuance of the Excise duty on Indian mill-made cloth as an unjust and unnecessary impost which presses heavily on the industry, and prays that it should be abolished at the earliest opportunity.

VII. WEIGHTS AND MEASURES.

RESOLVED—That this Conference invites the attention of the Government of India to the desirability of introducing uniform weights and measures to facilitate trade among the different towns and provinces of India, to prevent fraudulent practices of traders and remove the present inconveniences arising from a multiplicity of weights and measures and from a want of uniform system and standard.

VIII. OFFICE-BEARERS AND FUNDS FOR NEXT YEAR.

RESOLVED—That this Conference re-appoints Rao Bahadur R. N. Mudholkar as General Secretary and authorizes him to appoint an Assistant Secretary with suitable establishment and appeals to the public for a sum of Rs. 5,000 to meet the expenses of the next twelve months.

RAMESHWAR SINGH,
President.

R. N. MUDHOLKAR,
General Secretary.

30th December 1909. }

RESOLUTIONS OF THE SIXTH INDIAN INDUSTRIAL-
CONFERENCE

Held at Allahabad on the 30th December 1910.

I. VOTE OF SORROW FOR THE DEATH OF HIS LATE MAJESTY,
KING EMPEROR, EDWARD VII.

Resolved.—This Conference places on record its profound sorrow at the death of His late Majesty King-Emperor, Edward VII, in whom the people of India have lost a most sympathetic and warm-hearted well-wisher and supporter, the Empire a wise and benevolent sovereign and the world a powerful promoter of peace and general amity, and respectfully tenders its condolence to Her Majesty Queen-Empress, Alexandra and the members of the Royal Family.

[Put from the Chair in solemn silence, the whole audience standing and carried unanimously.]

II. HOMAGE TO HIS MAJESTY, KING-EMPEROR, GEORGE V.

Resolved.—This Conference begs to offer its respectful and loyal homage to His Majesty King-Emperor, George V, on his accession to the throne of the British Empire, and expresses the hope that His Majes-

ty's gracious sympathy for the people of this country and interest in their well-being will effectively promote their prosperity and advancement.

[Moved from the Chair and carried unanimously and by acclamation.]

III. TECHNICAL EDUCATION.

Resolved. (a)—While gratefully acknowledging the grants to technical and industrial education made by Government in recent years, this Conference places on record its firm conviction that, for effectively promoting the industrial progress of this country, it is essential that the Government should establish here at least one fully equipped Polytechnic College for imparting the highest kind of instruction in the applied sciences and industrial arts, and further urges that the visit of His Majesty, King Emperor, George V and Her Majesty, Queen Empress, Mary should be commemorated by the foundation of such an institution.

(b) This Conference also invites business, scientific and technical experts to form themselves into a working organization for the creation of a scientific, technological and commercial literature in the Indian Vernaculars for the dissemination of information on industrial and commercial subjects amongst the people of India.

[Proposed by Sir Bhalchandra Krishna, Kt. of Bombay, seconded by Pandit Gokarnanath Misra of Lucknow, supported by Babus Laxmi Chand and Thakur Prasad and carried unanimously.]

IV. COMMERCIAL EDUCATION.

Resolved (a)—In the opinion of this Conference the time has come for the Indian Universities to create Faculties of Commerce, to institute Degrees in Commerce, and to affiliate Commercial College, which will prepare candidates for such Degrees.

(b) That there should be established one College of Commerce in each provincial capital and that it should include provision for the training of teachers for commercial schools in the mofussil.

[Proposed by Mr. C. Gopal Menon of Madras, seconded by Mr. Gulabchand Javeri and carried unanimously.]

V. EXCISE DUTY ON COTTON GOODS.

Resolved.—This Conference again records its emphatic protest against the continuance of the Excise Duty on Indian mill-made cloth as an unjust and unnecessary impost which presses heavily on the industry and prays that it should be abolished at the earliest opportunity.

[Proposed by the Honourable Mr. Gokuldas K. Parekh of Bombay, seconded by Mr. Mathuradas Ram Chand Javari of Sind, supported by Mr. Mawjee Govindjee Sheth of Bombay and carried unanimously.]

VI. THE INDIAN FACTORIES BILL.

Resolved.—This Conference is of opinion that the provisions of the Indian Factories Bill of 1909 involve a serious, unnecessary and uncalled for interference with the rights of adult male labour and urges that the sections of the Bill which involve such restriction be dropped.

[Proposed by the Honourable Sir Vithaldas D. Thackersey, seconded by Mr. D. E. Wacha, supported by the Honourable Rao Bahadur R. N. Mudholkar and carried unanimously. Two amendments were proposed but they were lost.]

VII. MERCHANDISE MARKS ACT.

Resolved.—This Conference draws the attention of Government to the use, on several articles manufactured outside India, of misleading descriptions, impressions, or marks calculated to cause the belief among purchasers and consumers that the same were made in India and urges that steps be taken, by legislation, if necessary, to prevent such and similar fraudulent practices by requiring in every case the indication of the country of origin.

[Proposed by Mr. M. B. Sant, of Amraoti, seconded by Mr. J. P. Kotelingam of Madras, and carried unanimously.]

VIII. WEIGHTS AND MEASURES.

Resolved.—This Conference re-affirms Resolution No. VII of last year's Conference and again invites the attention of the Government of India to the desirability of introducing uniform weights and measures to facilitate trade among the different towns and provinces of India, and remove the present inconveniences arising from a multiplicity of weights and measures and from a want of uniform system and standard.

[Proposed by the Honourable Rao Bahadur R. N. Mudholkar, seconded by Mr. Goswami Brijnath and carried unanimously.]

IX. AGRICULTURAL BANKS.

Resolved.—This Conference notes with regret that the Secretary of State has not sanctioned the scheme drawn up by some of the leading financiers of Bombay of an Agricultural and Industrial Bank, though the same had received the support of the Government of Bombay and of the Government of India; and again urges upon Government its conviction that for securing an amelioration of the economic condition of the peasantry and the land-owning classes, it is necessary to establish agricultural banks for assisting the existing Co-operative Credit Societies and for advancing loans direct to agriculturists wherever such societies do not exist.

[Proposed by Mr. G. K. Devadhar of Poona, seconded by Mr. Mahesh Charan Sinha. Babu Ambica Charan Ookil moved an amend-

ment which the President ruled out of order. The original resolution was carried unanimously.]

X. JOINT STOCK COMPANIES.

Resolved.—This Conference considers that it is desirable to bring the law regulating Joint Stock Companies in India in a line with the law in England, as laid down in the recent Companies Consolidation Act, with such modifications as will suit the circumstances of this country.

[Proposed by Mr. J. K. Mehta of Bombay, seconded by Mr. B. F. Karbhari and carried unanimously.]

XI. ABOLITION OF THE DEPARTMENT OF INDUSTRIES.

Resolved.—This Conference records its sense of deep regret at the action of the Secretary of State in directing the abolition of the Department of Industries in Madras and lodges a protest against the policy laid down by him that the State should not pioneer new enterprises, as unduly limiting State help in industrial development.

[Proposed by Mr. C. Y. Chintamani, of Allahabad, seconded by the Honourable Sir Vithaldas D. Thackersey, and carried unanimously.]

XII. DUTY ON SUGAR.

Resolved.—This Conference is strongly of opinion that it is essential that the Government should impose an adequate import duty on foreign sugar in order to enable the indigenous industry to hold its own.

[Proposed by the Honourable Rai Bahadur Ramansj Dyal, seconded by Mr. J. P. Kotilingam and carried unanimously.]

A resolution on Octroi Duty levied in some parts of India was moved but its consideration was postponed owing to a difference of opinion.

XIII. APPOINTMENT OF OFFICE-BEARERS AND APPEAL FOR FUNDS.

Resolved.—That this Conference re-appoints the Honourable Rao Bahadur R. N. Mudholkar as General Secretary and authorizes him to appoint an Assistant Secretary with suitable establishment and appeals to the public for a sum of Rs. 5,000 to meet the expenses of the Industrial Conference Office for the next twelve months.

[Proposed by the Honourable Pandit Madan Mohan Malaviya, seconded by Babu Ganga Prasad Varma and carried unanimously.]

R. N. MOOKERJEE,
President.

R. N. MUDHOLKAR,
General Secretary.

ALLAHABAD,
The 30th December 1910 }

APPENDIX III.

Copy of Resolutions passed by the Punjab Industrial Conference on February 18th, 1911.

I.—GENERAL MATTER.

1. (a) That the Department of Industry should be controlled by a Director of Industries who should be a whole time officer assisted by an Advisory Board.

(b) That the Board of Industry should consist of several members in addition to its head.

(c) That the members of the Board of Industry should be nominated by the Lieutenant-Governor and membership should be honorary, but travelling and halting allowance under the Civil Service Regulations should be paid.

(d) That the members of the Board of Industry should by preference be—

(i) A chemist or a chemist and metallurgist combined.

(ii) A mechanical engineer with a knowledge of machinery as applied to industries.

(iii) The business experts with a sound practical knowledge of business.

(iv) Two financial experts such as managers of banks.

(v) A mining engineer or mineralogist.

(vi) A member of the educational department.

(vii) The Registrar of Co-operative Credit Societies.

2. That the duties of the department should be:—

(a) The collection and ledgering of information likely to be used in any of the industries in existence or suitable for creation in the Punjab and rendering such information available for the public.

(b) The assisting of all enquirers on technical subjects by chemical investigation, advice regarding machinery and generally by information of all sorts.

Note.—The Conference is of opinion that payment may reasonably be demanded for chemical analysis.

3. That it would be useful to appoint district correspondents to the Director of Industries.

4. That it is generally inadvisable for Government to establish model factories.

5. The Government can assist industries by—

(1) Exhibiting and demonstrating the use of improved appliances machines and industrial processes.

(2) Publishing leaflets on industrial processes.

(3) Encouraging district exhibitions.

(4) Dissiminating information through the agency of the press.

6. That co-operative societies of workers are useful, provided that the industries for which the societies are found are commercially sound.

7. The disabilities under which the local bulk industries labour and disadvantages which they encounter in comparison with similar products imported into the Punjab result very considerably from the irregularity of railway freights from and to the exporting port. The combination of unfortunate circumstances which affects so prejudicially local manufactures may be summarised as follows :—

(a) Comparative cheapness of carriage of raw material to Karachi due to the impression that the main Railway Goods Traffic is export.

(b) Cheapness of carriage of imported manufactured goods on the plea that these come as a windfall for the wagons which ordinarily should have travelled back empty.

(c) Heavy rates of carriage of locally manufactured goods because of their being higher in value than raw materials.

(d) The prejudicial working of a telescopic system of railway freights in the case of locally manufactured goods as very often the raw material has to encounter several breaks in the journey.

The above factors combine to create a sort of protection in favour of foreign manufactures. It is therefore recommended that—

(1) Freights on raw materials and articles manufactured out of the same should be at the same rates, e.g., freights on oil-seeds and oil should be at the same rates.

(2) Freights on the same articles whether manufactured in India or abroad should be the same, e.g., freights on English yarn and Indian yarn be at the same rates to and from Karachi.

(3) When a raw material has to travel to a factory and the manufactured article has to go out also by rail, freights for the two journeys should be equal to the freight which would have been payable if the raw material only had taken one journey from the starting station to the destination of the manufactured article; and this can be done by giving proper rebates

8. That with a view to the fostering of industries, the department of industries should move the Government to require that the accounts of joint stock companies should be submitted to competent audit. It seems most important to provide a large measure of protection for

investors and thereby to inspire public confidence. There should also be strict control by the institution of prosecutions by Government in cases of dishonesty.

9. That the Conference urges that Government should take early measures to remove the obstacles to the acquisition of sites required for factories and for industrial and commercial purposes caused by the existing provisions of the Pre-emption Act and the Land Alienation Act read with the executive instructions.

II.—INDUSTRIAL EDUCATION.

1. That the Conference, while recognising the value of the resolution of the sub-Committee quoted below, is of opinion that there has not been sufficient time in which to frame an adequate scheme of industrial education. It therefore recommends that Government should appoint small committee which shall, after considering the resolutions passed by the sub-committee and after inviting opinions from persons competent to give them, frame a practical scheme of industrial education.

The Conference further recommends that Government should inform the committee what funds will be available for industrial education in the near future in order that such a scheme may be prepared as may be introduced at once.

(1) That industrial schools should be established at the centres of important industries where up-to-date methods (under expert management) especially applicable to the industries of that locality be taught:—

(i) To boys and girls from 5 years old and upwards.

(ii) Also the adult men and women, and

(iii) That to the more flourishing of such schools advanced classes of more technical type be added, as occasion demands.

2. That the said schools should endeavour to train instructors who could subsequently be employed in promoting the introduction of improved methods and appliances in trades carried on by artisans working in their own houses or in small workshops.

(ii). For the schools contemplated in resolution 8 the proportion of working hours should be as follows —

First stage.— $\frac{2}{3}$ ds general education and $\frac{1}{3}$ rd craft education.

Second stage.— $\frac{1}{2}$ general education and $\frac{1}{2}$ craft education.

Third stage.— $\frac{1}{3}$ rd general education and $\frac{2}{3}$ ds craft education.

Provided that any boy, if the Principal of the school so decides, may devote the whole of his time to craft work.

Proviso I.—These proportions should by no means apply to the adults mentioned in resolution 8 nor to the advanced classes mentioned therein who would devote all their time to craft work.

Proviso II.—“Physical drill” and “Object lessons” as the expressions are understood in the Education Department should not be included in the proportion devoted to craft work.

Proviso III.—For the purposes of this resolution literary education shall (apart from drawing and clay modelling and such practical instruction) be understood to mean only education in ordinary vernacular; reading, writing, arithmetic and elementary geography (of India); and in the third state a little English, comprising reading, writing and conversation so as to enable foreman's orders and instructions to be understood.

(iii) There should be no restriction on the classes of boys admitted to the schools except that boys who are not the sons of artisans should be charged fees, which should be pitched low.

(iv) That Government schools should not be conducted as workshops working on a profit, and that in any case, the products from such schools (if so conducted at all) should be sold to private orders and at prices which will not undersell the general market.

That grants by Government to private industrial schools should be regulated by the efficiency of the schools and given under grant-in-aid rules and not according to the profit or loss being made by the schools, and that the grant-in-aid system requires further development.

(v) That the individual or body contributing the funds should manage the schools, and that the functionary in immediate charge of each individual school should be a man who has received a technical education such as is contemplated by the schools now recommended only to a higher and collegiate standard.

For example (a) a man might be sent for training at the expense of Government or of a local body to the Victoria Technical Institute, Bombay, the Rurkec College, or to the Serampur Weaving School, Bengal, or to other similar institution in India, or (b) it might be found more satisfactory to entertain such graduates of these institutions who had actual practical experience, or (c) even to entertain experts imported from foreign countries.

8. That the industries in which schools are required are—

1. Pottery.
2. Metal work including cutlery.
3. Wood work including carpentry and cabinet making.
4. Cotton weaving.
5. Spinning and weaving of silk and wool.

- | | |
|--|-----------------------------------|
| 6. Knitting and hosiery | } particularly for women workers. |
| 7. Lace and drawn thread work | |
| 8. Kandra and gold and silver lace work. | |
| 9. Nickel plating. | |
| 10. Lacquer work. | |

That it should be left to the Advisory Board to advise in what places the schools should be established.

4. That industrial education should be administered by the Director of Industries and the Advisory Board assisted by an expert industrial inspector imported from Europe.

5. That particular stress is laid on the great efficacy of the apprentice system, and that it is not only legitimate but advisable to give grants to factories for the training of apprentices, provided, however, that the factory receiving a grant is required to permit official inspection by the Director of Industries or his officers, to see that the apprentices are receiving proper training.

III.—SPECIAL INDUSTRIES.

1. *Tanning*.—Difficulty—Want of up-to-date technical knowledge. *Recommendations* (1)—That the present system of curing hides and skins for the market is defective and the department of industries should institute enquiries into the matter. (2) That there should be expert enquiries as to the places where improved methods of tanning could be introduced with advantage having regard to the supply of raw materials to water, labour and tanning materials. (3) That Government should make arrangements for the practical training of youths in up-to-date tanneries already in existence in India by a system of premium or otherwise.

2. *Oil-Pressing*.—Difficulty—Castor-seed. There is difficulty in disposing of castor cake at remunerative rates in the Punjab. Also the supply comes only from the United Provinces.

Recommendations.—That as the only use of castor cake is for manurial purposes, manure rate might be conceded by the railway.

3. *Cotton seed*.—Difficulties (1)—It is believed that if half the price of cotton seed can be obtained for the cake, pressing will pay.

(2) Inferiority of local seed out of which only 15 per cent. oil can be extracted.

(3) Dearthness of seed—cost being greater in the Punjab than in the United Provinces.

Recommendations.—(1) That an experimental distribution of cotton cake on payment of one-half the cost of cotton seed be undertaken by

the Agricultural Department conjointly with an established factory in order to test the market for the by-product.

(2) That it is premature to start oil refineries.

4. *Fibres*.—The question of fibres is already receiving the special attention of the Agricultural Department, and the Conference have no suggestions to offer.

5. *Wood pulping*.—Information is required on the following points:—

(i) The tracts in which wood suitable for pulping can be found.

(ii) An estimate of the number of trees available for pulping annually for an indefinite period and also the number per acre.

(iii) The probable cost of the standing trees by girth measurement.

(iv) Probable cost of carriage of the timber to the railway line where in all probability factories would be established.

6. *Match making*.—The monograph published recently by the Government of India contains all necessary information on the subject, and the Conference have no further suggestions to offer.

7. *Glass making*.—Difficulties.—The chief difficulties are—

(1) Cost of alkali.

(2) Cost of coal.

(3) Want of skilled labour.

(4) That any factory to pay must include the manufacture of window and plate glass and bottle making by machinery. This entails a larger capital than has been at the disposal of companies hitherto established.

Recommendations.—(1) In view of the above considerations great care should be taken in the starting of glass factories in the province.

(2) With regard to existing concerns liberal conditions as to railway freights might be made.

(3) That a careful survey be made by Government of the quartzes and sands in the Punjab suitable for glass-making. Samples being collected through local agencies to guide an expert of the Geological Department, who should carry out a detailed survey subsequently. That with a view to the establishment of glass factories in the province enquiries should include the location of the other substances necessary to the industry such as soda and lime-stone.

8. *Hosiery*.—*Recommendations*.—(1) That knitting classes especially for *parda-nashin* women on the lines of the one at Bara Banki should be established in places such as Lahore, preferably in connection with existing educational institutions.

(2) That the establishment of a knitting machine industry is not sufficient to guarantee success, but proper arrangements must be made

to supervise the necessary supplementary work such as stitching, washing, &c., and for the supply of material and the disposal of products.

9. *Dyeing.—Recommendations.*—That a class for the dyeing of yarns and fabrics with fast colours should be established in connection, if possible, with an existing educational institution in Lahore, on improved methods with both indigenous and foreign dyes.

10. *Sugar refining.*—That any improvement in sugar manufacture as distinct from gur making must depend upon concentration on a large scale by co-operation or otherwise, and until this is possible in the Punjab the matter is rather an agricultural than an industrial question.

11. *Weaving.—Difficulty.*—The want of up-to-date technical education. *Recommendations.*—(1) That Government should give a further grant to the Ludhiana Weaving School to enable it to purchase dobbies and jacquered looms and to improve its dyeing and sizing processes.

(2) That travelling exhibitions of improved weaving appliances should be given a fair trial.

12. *Pottery and crockery.*—That the use of glazed pottery for domestic purposes is likely to increase rapidly in the province where there is already a small manufacture of cheap glazed pottery utensils. The investigation of the most useful type of firing kiln is recommended as this seems at present to be the weak point of the industry.

In view of possible extension, a survey of the clays, marls, quartzes and other pottery materials of the province is desirable.

13. *Gold and silver tinsel.*—The Delhi hand industry is very seriously affected by the competition of machine-made tinsel and wire from Europe and seems likely to disappear altogether. The processes in use in Europe are jealously guarded. The best chance of success seems to consist in inquiries by the department of industries from the makers of machinery for rolling and drawing metals. It is noted that the Madras Government had instituted enquiries through Mr. Chatterton as regards the more economical European methods and have promised to apprise the Punjab Government of the result.

14. *Metal foundries.*—There appear to be no serious difficulties in the way of development.

15. *Chemical industries.*—There are two factories for sulphuric acid at Delhi and two at Lahore, the raw material being imported from Sicily. These industries are favoured by the heavy freights on imported sulphuric acid. The Geological Department is making the necessary survey of the resources of the province as regards sulphur and sulphur compounds. As soon as a demand arises for sodium, carbonate and caustic soda there would appear to be no difficulty in manufacturing

these in large quantities in the Punjab from the existing deposits of sodium chloride provided electric power is made available.

16. *Soap and glycerine.*—Two kinds of soaps are in use—toilet soap and soap for washing clothes. The raw materials for both are available. Dhobi soap is largely manufactured locally and gives satisfaction. No action seems to be necessary in this connection. As regards toilet soap there is an up-to-date factory at Meerut, and there are some small institutions in the Punjab, but the local products do not compete successfully with imported soaps. The reason for this would appear to require investigation. Attention might especially be directed to a comparison of prices, qualities, distributing agencies and disposal of by products, such as glycerine.

17. *Industrial alcohol distilling.*—The valuable note by Mr. Barnes may be taken as a guide for the department of industries in preliminary work needed in this connection.

18. *Use of waste products of tanning.*—The chief waste product of tanning is glue, and as there is a considerable export of hide parings, the department should consider why capital is not attracted to the starting of a glue factory, especially as size is largely used in textile industry. The causes of inaction may be the costs of fuel or perhaps prejudice.

APPENDIX IV.

LIST OF DELEGATES TO THE SEVENTH INDIAN INDUSTRIAL CONFERENCE, HELD AT CALCUTTA ON

29TH DECEMBER 1911.

(1) *Elected by the South Indian Association, Madras:—*

1. The Honorable Dewan Bahadur L. A. Govinda Raghava Aiyar.
2. The Honorable Mr. T. V. Sheshagiri Aiyar.
3. The Honorable Mr. N. Subba Rau Pantulu.
4. Mr. S. Sreenivasa Aiyengar.
5. Mr. T. V. Gopaldaswamy Mudaliar
6. Mr. S. Gopaldaswamy Aiyengar.
7. Mr. K. B. Ramanadha Aiyar.
8. Mr. C. Gopal Menon,
9. Mr. C. P. Ramaswamy Aiyar.
10. Mr. A. Rangaswamy Aiyengar.

(2) *The National Found and Industrial Association Madras:—*

1. The Honorable Nawab Syed Mahomed Sahib Bahadur.
2. The Honorable Dewan Bahadur L. A. Govinda Raghava Aiyar, B.A., B.L.
3. The Honorable Mr. T. V. Seshagiri Aiyar B.A., B.L.
4. Dewan Bahadur M. Audinarayaniah Garu.
5. The Honorable Mr. N. Subba Rau Pantulu Garu.
6. Mr. T. Rangachariar, B.A., B.L.
7. Mr. S. Strinivas Aiyengar B.A., B.L.
8. Mr. V. Ryrus Nambiar B.A., B.L.
9. Pandit D. Gopala Charlu A.V.S.
10. Dewan Bahadur Govindas Chatur Chujdas.
11. Mr. S. Raja Gopala Chariar.
12. Mr. M. R. Ramasbesha Aiyar.
13. Mr. T. V. Gopala Swami Mudaliar B.A., B.L.
14. Mr. Vidya Sagar Panday.
15. Mr. C. Gopal Menon.
16. Mr. A. C. Parthasarathy Naidu.
17. Mr. K. B. Ramanath Aiyar.
18. Mr. D. V. Hanmantha Rau.

(3) *By the Mining and Geological Institute of India, Calcutta:—*

1. Mr. P. Brubb, Principal C. E. College Sibpur.

2. Mr. E. H. Robertson, Professor of Mining, C. E. College
Sibpur.
3. Lt Col. T. C. Hughes, Hims asoay Office Calcutta.

(4) *By the Marwari Association, Calcutta :—*

1. Babu Debi Prasad B. A.
2. Babu Roor Mall Goenka.

(5) *By the Deccan Agricultural Association, Poona :—*

1. Sirdar J.B. Potins.
2. Mr. B.S. Kamat B.A.

(6) *By the Provincial Committee of the Industrial Conference, Berar—*

1. The Honorable Rao Bahadur R. N. Mudholkar, Advocate
Amroti.
2. Rao Bahadur Rg. Mundle.
3. Rao Bahadur Deorao Vinayak.
4. Mr. V.M. Mahajani.
5. Mr. R.V. Mahajani.
6. Mr. M.V. Joshi,
7. Mr. B.R. Landge.
8. Mr. B. Sant,
9. Mr. G.R. Kshireagar.

(7) *Millowner's Association Bombay—*

1. The Honorable Sir Vithal Das D. Thackersey Kt.
2. The Honorable Sir Sasson David Bart.
3. Mr. Dinshaw E. Wacha.

(8) *The Indian Merchants' Chamber and Bureau*

BOMBAY.

1. The Honorable Sir Vithaldas D, Thackersey Kt.
2. Mr. D.E. Wacha.
3. Mr. Gulabchand Devchand Javeri.
4. Mr. Piroz Shaw Hornusji Daver.

REPORT

ON THE WORK OF THE

Indian Industrial Conference

INCLUDING A

RECORD OF THE GENERAL INDUSTRIAL ACTIVITY
IN THE TWELVE MONTHS

December 1910 to November 1911

MADRAS : G. C. LOGANADHAM BROS.
THE GUARDIAN PRESS, MOUNT ROAD
1911

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REPORT
OF
INDIAN INDUSTRIAL CONFERENCE WORK
AND RECORD OF

**General industrial activity in the country in the
twelve months ending with November 1911.**

PART I.

INDUSTRIAL CONFERENCE WORK.

December 1910.

THE report submitted to the Sixth Indian Industrial Conference, held at Allahabad in December 1910, covered the period of twelve months from December 1909 to November 1910. During the months of November and December 1910, the office of the Industrial Conference was engaged in correspondence with the office bearers of the Reception Committee of the Conference formed at Allahabad, for the purpose of making the arrangements in connection with the last session. To help the local Committee, the Assistant Secretary, Mr. M. B. Sant, proceeded to Allahabad some days before the meeting of the Conference. This function took place on the 30th December 1910, in the spacious pavilion erected for the Indian National Congress, under the Presidentship of Mr. R. N. Mookerjee, C. I. E. The resolutions passed, the papers laid on the table, the speech of the Chairman of the Reception Committee, the Honourable Pandit Madan

Mohan Malaviya, the Presidential address, speeches on the resolutions, &c., will be found in the printed Report.

The grateful thanks of the Conference, are due to the writers of the papers on divers subjects of practical importance, a careful perusal of which will amply repay the efforts of those who are either anxious to study Indian economic questions or desirous of starting an industry.

January to November 1911.

By resolution No. XIII of the Allahabad Conference, the Honourable Rao Bahadur R. N. Mudholkar, was re-appointed as General Secretary and was entrusted with the power of appointing an Assistant Secretary with suitable establishment to carry on the Conference work during the year and to appeal to the general public for raising a sum of Rs.5,000 to meet the expenses during the next twelve months. Agreeably to this Resolution printed appeals for funds were sent out to the principal Zamindars, leading industrialists and prominent gentlemen of all the provinces. But the response this year was not at all encouraging. Out of Rs. 5,000 the sum of Rs. 2,435 only has been realised till now. Some of the persons who have held high positions in the Congress organisation and occupy a similar position in the country, have not given to the institution the help which they owe it to themselves and to the country to give. But we have not abandoned our hope about them and trust that they will still realise their duty. The difficulties of the Conference Office were further greatly enhanced by the failure of the Reception Committee of Allahabad to meet the charges which legitimately fell upon them and were incurred for them. The amount of subscriptions actually collected has hardly sufficed to meet the expenses of the office and the Allahabad Conference and left no scope for the further expansion of the Conference activity by the appointment of

an additional Assistant Secretary to visit the different parts of the country for spreading knowledge of the aims and objects of the Indian Industrial Conference and rousing the interest of the people in the industrial development of the country on the proper lines. There is any amount of very necessary and important work to be done. Provincial and District Committees have to be reorganised; in many places they have to be established. The activity and interest of the existing Committees have to be stimulated. The zeal and enthusiasm of 1905, 1906, and 1907, are succeeded by a re-action and torpor. This regrettable and undesirable state has to be removed.

During the year some suggestions were received for issuing a Bulletin of industrial information involving an approximate expenditure of Rs. 5,000 for a period of at least two years, until the magazine become self-supporting. This is no new idea. The Conference expressly dealt with it five years ago. But unless the men of light and leading in the country give their support in the only tangible manner that can serve any useful purpose nothing can be done. Platonic sympathy and expressions of approval are not enough.

The General Secretary of the Conference took advantage this year also of the opportunity afforded to him by a seat in the Imperial Legislative Council to invite the attention of the Government to the need of greater and more liberal provision for Technical Education and with that view gave notice of the following resolution which he proposed to move at the Council meeting of January last:

That this Council recommends to the Governor General in Council that the Government of India do appoint a Committee of qualified officials and non-official persons to inquire and report upon—

(1) How far there is a present demand for instruction

in railway engineering, marine engineering, ship-building and navigation, mining engineering and mining chemistry, metallurgy and metal manufacture, the different departments of industrial chemistry and the higher courses in mechanical and electrical engineering and textile manufacture.

(2) How far such demand is or can be met by existing institutions with their present staff and equipment.

(3) Whether and how far further and better provision can be made by developing these institutions and by securing for them the co-operation of workshops and establishments belonging to the State or local authorities, public corporations or subsidized companies.

(4) Whether it would be necessary to create any new institution for any of these purposes.

And do further instruct such committee to make definite proposals for giving effect to their conclusions, should they be of the opinion that action on the part of Government is necessary or desirable.

Some three days before the date of the meeting the Government of India intimated to him through the Honourable Mr. Butler that they were prepared to refer the questions raised by him to the Educational Conference which had been summoned to assemble at Allahabad in February and to which he also had been invited and whether in view of this he would still proceed with his motion. The Government having practically granted the enquiry, which was wanted, the resolution was withdrawn.

In the Educational Conference which met at Allahabad in the second week of February, one day was assigned to the discussion of the needs and requirements of the country generally and of the different provinces, in regard to Technical education. The printed report

of the proceedings of the Conference gives a summary of the interesting and informing discussion which took place and in which part was taken by scientists, specialists, experts and practical men of business, and of the recommendations made by them. These will be found at pages 5 to 13 of the publication entitled "Selections from the record of the Government of India, Department of Education Serial No. 1."

It is an encouraging sign of the times, that the cause of the industrial regeneration of India is being recognised as a field of common endeavour by even outside critics of Indian affairs. Mr. Valentine Chirol, the correspondent of the *London Times*, says in reference to this :—

"There may be differences of opinion between Englishmen and Indians as to the best form of Government and as the best methods of administration in such a country as India and there must obviously always be profound differences of opinion between them on questions appertaining to the domain of religion and ethical thought. * * * But there is no field of common endeavour in which the Englishmen and Indians can work so usefully and cordially together as the immense field afforded by the economic development of India, and none in which success would do so much to hasten the accomplishment of many of the most legitimate aspirations of the Indian peoples."

The Assistant Secretary Mr. Sant could not be spared this year also for touring work during the year under report on account of the heavy pressure of office work, especially as he had to devote a considerable time and attention to the compilation of the Guide to Modern Machinery compiled in this office materials for which had to be collected from various sources, and classified under appropriate headings. He however, attended the Second General Meeting of the Deccan Agricultural Association, Poona,

and visited a few insitutions in the mofussil. An account of his tour is appended to this Report.

The Resolutions passed at the Sixth Indian Industrial Conference were submitted to the Government of India, the Provincial Governments, as also the Governments of the principal Indian States for information and necessary action.

A revised and enlarged edition of the Directory of Indian Goods and Industries could not be issued this year also, as there are still a few copies remaining on hand. The demand for this publication, is not as keen as in the beginning, and until the stock on hand is sold it is not deemed desirable to bring out the 5th edition which is under preparation.

The Guide to Modern Machinery, reference to which was made in last year's Report is now ready and is submitted to the Conference. This is the first attempt of the kind made in India, to bring together within the compass of one handy book, the names and addresses of makers of Machinery required in the different industries carried on in this country. There is reason to hope that this publication will be of some help also to persons desirous to start new industries. The whole work of compilation and preparation for the press fell on Mr. M. B. Sant and his Assistant, Mr. G. R. Kshirsagar.

The demand for the Directory of Technical Institutions in India still continues but is not as brisk as might be desired and the issue of a revised edition cannot be undertaken until the first edition is sold.

During the last twelve months, Industrial and Agricultural Exhibitions, Cattle shows, &c. were held in many places in all provinces of India. They will be found described in Part II dealing with the work in the respective provinces, in which they were held. The most notable

event of the year was the United Provinces Exhibition held at Allahabad which was one of the largest and most impressive shows held in this country.

The proposals made by the Industrial Conference in regard to Industrial Surveys, are, it is gratifying to observe bearing fruit. The utility and importance of Industrial Surveys or investigations into special branches of it are now generally recognized and even small Indian States have undertaken such surveys or inquiries.

It is felt by several friends of the Industrial Conference movement that the organisation has reached a stage when it should introduce in its programme a more practical feature than the collection of monograms and papers and the passing of general resolutions. It is admitted that the papers prepared for the Conference and laid on its table furnish highly useful material and a valuable literature on important industrial and economic questions has been obtained. Our conditions require a further advance, and the Conference ought now to arrange for the practical discussion of one, or more selected industries like sugar manufacture, the extraction and refinement of oils, preparation of leather by chrome tanning and other processes and should secure symposia on the subjects from experts and manufacturers. Efforts are being made to give effect to this idea from this year; but it is doubtful whether under the peculiar circumstances of this year, a day can be secured for this greatly desirable object in Christmas. The industry suggested is the sugar industry, its present condition, the difficulties it has to encounter and the methods for overcoming them. In the Agricultural Conference summoned to meet at Pusa next month the sugar industry is set down for discussion. The deliberations of that Conference are awaited with great interest.

Part III Sections A and B are devoted to a detailed

account of the general industrial activity in the country including a description of the steps taken by the Imperial and Provincial Governments in British India and the Indian States. This information has been as usual compiled from all available sources both official and non-official.

The list of Indian Patentees and of new companies registered during the year are appended to this report as annexures.

We beg to repeat our sincere acknowledgments to the Imperial and Provincial Governments and the Rulers of Indian States for the annual reports and other departmental publications supplied by them to the Conference Office.

Mr. M. B. Sant, Assistant Secretary has done his work with zeal. Mr. G. R. Kshirsagar, the second Assistant has also given satisfaction.

Statements showing the receipts and disbursements of the office of the General Secretary are appended.

R. N. MOOKERJEE,
President,
Sixth Indian Industrial
Conference.

R. N. MUDHOLKAR,
General Secretary,
Indian Industrial Conference.

30th November, 1911.

Summary of Accounts of the Office of the Indian Industrial Con-

Receipts.				Amount.
				Rs. A. P.
Opening balance	...	...	...	2,586 3 3
From sale proceeds of the Directory of Indian Goods and Industries	...	...	...	384 8 0
Do Directory of Technical Institutions in India	...			86 10 0
Do Benares Industrial Conference Report	...			3 10 0
Do Calcutta do do	...			10 2 0
Do Surat do do	...			22 10 0
Do Madras do do	...			79 6 0
Do Lahore do do	...			995 0 0
Advertisements for Allahabad Conference Report	..			32 0 0
<i>Donations :—</i>				
R. N. Mookerjee Esq., C. I. E., Calcutta	...	...	...	500 0 0
The Honorable Sir Vithaldas D. Thackersey, Bombay	...			200 0 0
The Honorable Mr. Gokuldas K. Parekh, Bombay	...			150 0 0
The Honorable Rao Bahadur R. N. Mudholkar, Amraoti...	...			100 0 0
The Honorable Mr. V. Krishnaswamy Iyer, Madras	...			100 0 0
R. Ramachandra Esq., Nellore	...	...	...	100 0 0
Dr. Harold H. Mann, Poona	...	...	...	100 0 0
Sir Dorab J. Tata, Kt., Bombay	...	...	...	100 0 0
Sir Bhalchandra Krishna, Kt., Bombay for 1910	...			100 0 0
Do for 1911	...			100 0 0
M. V. Joshi Esq., Amraoti	...	...	...	100 0 0
Messrs. Morajee Gokuldas and Co., Bombay	...			100 0 0
Shet Khimjee Assur Veerjee, Bombay	...	...	...	50 0 0
S. N. Pandit Esq., Bar-at-Law, Rajkote	...	...	...	50 0 0
Khan Bahadur Bezouje Dadabhoy, Manager, Empress Mills, Nagpur	...	...	...	50 0 0

ference for the 12 months from December 1910 to November 1911

Receipts.	Amount.
	Rs. A. P.
Sirdar Madhav Rao V. Kibe Dewan (junior branch) Dewas.	50 0 0
The Honorable Mr. P. Sivasawmy Iyer, Madras ...	50 0 0
Professor Radha Kumud Mookerjee, Calcutta ...	50 0 0
Professor Benoy Kumar Sarkar, Calcutta ...	50 0 0
Shrimant Appa Saheb Patwardhan, Chief of Sangli ...	50 0 0
Wasumull Assumull Esq. ...	30 0 0
Dinshaw Eduljee Wacha Esq. ...	25 0 0
Through Mr. A. N. Datar, Baroda ...	25 0 0
Rao Bahadur Kandubhai G. Desai, Surat ...	25 0 0
Mathuradas Ramchand Javeri Esq., Hyderabad, Sind ...	20 0 0
C. Vijiaraghavachary, Salem ...	20 0 0
Rao Bahadur V. M. Kolhatkar, Nagpur ...	20 0 0
Professor Ruchiram Sahni, Lahore ...	15 0 0
T. V. Sheshagiri Iyer Esq., Madras. ...	15 0 0
V. Ramesham Esq., Madras ...	10 0 0
R. V. Mahajani Esq., Akola ...	10 0 0
S. B. Gokhale Esq., Hoshangabad for 1910 ...	10 0 0
Rao Bahadur R. G. Mundle, Yeotmal ...	10 0 0
Pandit Gokaran Nath Misra, Lucknow ...	5 0 0
Sir Gooroodas Bannerjee, Calcutta ...	5 0 0
Dewan Bahadur K. Krishnasawmy Row, Madras ...	5 0 0
Rai Bahadur Lala Vaijanath, Benares ...	5 0 0
S. B. Gokhale Esq., Hoshangabad for 1911 ...	5 0 0
Shankar M. Moholkhar, Esq., Akola ...	5 0 0
R. B. Oke Esq., Akola ...	5 0 0
Total ...	6,685 1 8

Summary of Accounts of the Office of the Indian Industrial Conference for the 12 months from December 1910 to November 1911.

Disbursements.	Amount.
	Rs. A. P.
Pay of Assistant Secretary and other Establishments ...	1,594 0 6
On Directory of Indian Goods and Industries account ...	76 14 0
On Directory of Technical Institutions in India account ...	11 14 0
Do Report of the Calcutta Industrial Conference account ...	0 12 0
Do do Surat do ...	1 9 0
Do do Madras do ...	1 11 0
Do do Lahore do ...	152 7 0
Printing charges of the Annual Report of the work of the Indian Industrial Conference including a record of the General Industrial activity for the year ending with November 1910 ...	122 6 0
Balance out of printing charges of the Report of the Lahore (Fifth) Indian Industrial Conference ...	850 0 0
Refund of the Sale-proceeds of the Benares Conference Report ...	3 10 0
Miscellaneous expenses incurred in connection with the Allahabad Industrial Conference, including messing and accommodation charges of Asst. Secretary and Office Establishment ...	95 8 0
Travelling expenses of Assistant Secretary and other miscellaneous charges incurred on tour ...	244 1 0
Printing (Miscellaneous) ...	48 14 0
Postage ...	186 6 6
Telegrams ...	15 2 0
Stationery ...	68 14 6
Books and periodicals ...	79 13 0
Book-binding, &c. ...	19 4 0
Railway freight ...	10 8 0
Advertising charges ...	30 4 0
Furniture ...	23 0 0
Sundries ...	4 4 0
Lighting charges ...	4 15 0
Typewriter repairs and other supplies ...	60 15 0
Expenditure ...	3,657 1 0
Balance ...	2,978 0 3
Total ...	6,635 1 3
*Out of the balance the following charges have to be paid.	
Cost of printing the Report of the Allahabad Industrial Conference about ...	Rs. 1,000
Furniture for office ...	" 100
Total ...	" 1,100

AMRAOTI,
1st December 1911.

R N. MUDHOLKAR,
General Secretary,
The Indian Industrial Conference.

REPORT SUBMITTED BY THE ASSISTANT SECRETARY.

As pointed out by the General Secretary in his Annual Report, I could not be spared this year also to undertake extensive touring for the purpose of rousing public interest in the Industrial Conference movement, reviving Provincial Committees and spreading knowledge of the aims and objects of this organisation, as much of my time was taken in the compilation and preparation for the press of the Guide to Modern Machinery and of the materials for the Allahabad Industrial Conference Report, in addition to the ordinary office routine work.

After the close of the Allahabad Session of the Industrial Conference, I visited the U. P. Exhibition held under Government auspices. The Exhibits in the Industrial and Agricultural Courts were very instructive. As this Exhibition has been noticed under U. P. Government in the body of the Report, it is not necessary to refer to it here in detail.

In the month of March, I accompanied the Honorable Rao Bahadur, R. N. Mudholkar, the General Secretary to Calcutta, to help him in his work.

In April last, I proceeded to Poona, and with the help of a few gentlemen, who take genuine interest in industrial matters, tried to enlist the sympathy of some prominent gentlemen in the work of the Conference office. In September, I attended the Second General Meeting of the Deccan Agricultural Association of Poona, held under the Presidentship of His Excellency Sir George Clarke, the Governor of Bombay and took part in the discussions on papers on "Lac Industry" and "Selection of Seed" read on the second day.

On the 3rd October I proceeded to Akola to attend the meeting specially held in the Hall of the Berar Oil Works in honor of The Honorable Mr. R. H. Craddock, the Chief Commissioner of the Central Provinces and Berar, when I had an opportunity to have a view of the splendid and up-to-date Machinery set up for the purposes of extracting and refining cotton seed oil and linseed oil, preparation of oil cakes and the manufacture of other bye-products. This is probably the best Factory of its kind in the whole of India and its products have already been highly spoken of by experts like Dr. Mann. This factory owes its origin and present development to the indefatigable energy and laudable enterprising spirit of the Hon'ble Rao Bahadur R. N. Mudholkar, who has established this concern with the help of Rao Bahadur Deorao Venayek and a few other leading gentlemen. I found a careful observation of the different processes in operation in this factory to be an education by itself.

While in Akola, I made an effort to approach the leaders of the place and with the sympathy and help of Rao Bahadur Deorao Venayek a conversazione was arranged in the Hall of the Native Mill Office, when subscriptions amounting to Rs. 86 were promised on the spot in aid of the Conference movement. I visited the Shree Luxmi Oil Mill, Akola of which Rao Bahadur D. V. Bhagwat is one of the Directors. This concern though working on a smaller scale appeared to be in a thriving condition and extracts Linseed and Til Oils, the cake being sent to Liverpool, there being no local demand. I also paid a visit to Roger's Industrial School of Akola where through the courtesy of the Superintendent, I had an opportunity to see the various departments. The School is not progressing well, it was said, for want of funds.

1st December, 1911.

M. B. SANT.

PART II

A brief account of the Industrial activity in India during the twelve months from December 1910 to November 1911.

Section A

The Governments of British India and Indian States and Industrial development.

BRITISH INDIA.

GENERAL

1. Since the inauguration of the reformed Legislative Councils, a new channel has been opened for the leaders of public opinion to bring to the notice of the Imperial and Provincial Governments several matters affecting the economic and industrial welfare of the country and the promotion of technical, and other practical education.

The work of the General Secretary in this connection has been detailed already in Part I of the Report and need not be repeated here.

The Hon'ble Mr. M. B. Dabthoy moved the following resolution in the Imperial Legislative Council :—

That in view of the continued depression in the Indian cotton industry, this Council recommends to the Governor-General-in-Council that the countervailing excise duty on cotton goods manufactured in India be abolished.

The resolution was lost there being 20 for and 82 against it.

Purchase of Government stores by Government departments formed the subject of interpellation by the Hon'ble Pandit Madan Mohun Malaviya, who asked :—

“ Whether the attention of Government had been drawn to the portion of Mr. R. N. Mookerjee's speech at the last Industrial Conference dealing with the rule for the supply of

articles for public service ; if so, whether Government is disposed to make a suitable revision of the said rule in the interests of manufacturers and merchants in India."

It was pointed out in reply that the new rules enacted on the subject in July 1909, did not affect the interest of the Indian Manufacturers, and as regards the merchants who deal in imported stores, the new rules are more liberal than the old ones they replaced.

2. At the instance of the Director-General of Commercial Intelligence, Mr. D. Hooper of the Indian Museum and Dr. J. W. Leather of Pusa, have discovered a process of removing the acidity of the cotton seed oil, which is associated with the reddish brown colouring matter. By using a small percentage of alkali and by subsequent washing, the experimenters have succeeded in producing a refined oil possessing the same yellow colour and edible properties as those of Egyptian cotton seed oil.

3. In pursuance of the resolution of 1909 of the Government of India, entrusting the Director-General of Commercial Intelligence with the work of collecting information regarding the resources of the Indian manufacturers, Mr. Noel Paton, the present Director-General has prepared a detailed catalogue of the Indian manufactures. The catalogue essays to give a list of the articles or component parts of machinery, etc., based on two years' actual indents on the store department of the India office for supplies which can be satisfactorily manufactured or procured in this country. There is thus no claim made in this publication at completeness. As the catalogue does not give the names of dealers or manufacturers of the articles detailed therein and as it differs also in the arrangement of its matter and classification of the goods it will serve a different purpose from that of the Directory of Indian Goods and Industries compiled by the Industrial Conference Office, the demand for which will, it is hoped, continue as hitherto and will not be affected by this publication.

4. We learn that the Government of India have under

actual consideration, a proposal to erect wheat elevators in suitable localities in different provinces of India for the purpose of holding large stocks of wheat safe from attacks of weevil and damp till the prices are favourable for them in the markets of the world. The causes which have brought this question to the front can be traced to the tendencies of the wheat merchants in India, in sending out almost the entire stock of wheat to foreign countries in a couple of months, which are quite unsound from business point of view, as owing to abnormal exports, the prices in foreign markets suddenly fall.

5. With the assistance of the Railway board, experiments are being conducted by Messrs. Killick Nixon & Co., of Bombay to powderise Indian soft woods for making blocks, sufficiently hard for adoption as Railway sleepers.

6. It is reported that Punjab had to forego the State Technical Scholarship this year for cotton seed oil milling and refining, as there would be difficulty in obtaining facilities for training in this industry and as the selected candidates were to leave India by the middle of August, there was hardly sufficient time to choose another industry and invite fresh applications.

7. The latest review of the mineral productions of India by Sir Thomas Holland and Mr. Leigh Fermor for 1910 contains much useful information. The most important mineral discovered at the commencement of the year is Monazite ; a large deposit of this mineral was found by Mr. C. W. Schomburg of Waltair who represents the London Cosmopolitan Mining Co., Ltd. There are several deposits of this mineral, from Cape Comorin to about 100 miles North. This discovery illustrates further the similarity between the crystalline areas of Brazil and India. Columbite, or Tantalite, Titamum and several metals also have been discovered by the officials of the Geological department.

8. The Government of India have this year sanctioned the award of 10 State Scholarships to the following candidates as per list given below with the subject :—

RECOMMENDED BY THE BOMBAY GOVERNMENT.

Mr. P. V. Mahd, for the manufacture of tanning extracts and their use in tanning.

RECOMMENDED BY THE MADRAS GOVERNMENT.

Mr. M. C. Sitaram for weaving and Mr. H. Sakharam Rao for textile manufacture.

RECOMMENDED BY THE BENGAL GOVERNMENT.

Mr. H. D. Barnett and Mr. Phani Bhusan Ray for Mechanical and electrical engineering.

RECOMMENDED BY THE GOVERNMENT OF THE
UNITED PROVINCES

Mr. Ramchandra Shrivastava for sugar manufacture.

RECOMMENDED BY THE GOVERNMENT OF THE
EASTERN BENGAL AND ASSAM

Mr. Abinash Chandra Datta for silk weaving, dyeing and finishing.

RECOMMENDED BY THE CHIEF COMMISSIONER, CENTRAL
PROVINCES

Mr. M. Ghulamali Mahammadi for manufacture of oils, fats and their products.

RECOMMENDED BY THE CHIEF COMMISSIONER
OF COORG

Mr. K. M. Muttanna for Mechanical Engineering.

RECOMMENDED BY THE CHIEF COMMISSIONER OF
AJMERE, MERWARA

Mr. Ram Lal for cotton spinning and weaving.

9. For the discussion of matters relating to general and industrial education, a Conference of Directors of Public Instruction with other officials, and a number of non-official gentlemen, was held at Allahabad in the beginning of the year

under review, with the inauguration of the department of Education. The first day was devoted to the discussion of Primary Education, and on the second day the Conference discussed the draft Resolution, which the Hon'ble Mr. Mudholkar had proposed to move in the Imperial Legislative Council. The text of the Resolution will be found given in the Part I of this Report. The discussion was very instructive and will, it is hoped, pave the way to some practical results.

10. According to Mr. Troup of the Imperial Forest Department woods suitable for Match Factories are available in the following localities :—

Punjab.—Mooltan and Kandra Divisions, but there is not room for a promising industry.

Bengal.—Calcutta, Kulna, and Port Canning are the only suitable places, 4 Factories are already working in Bengal.

Eastern Bengal and Assam.—Kulsi N. Karup, Barpathar, Badurpur, Longuimukh, Nahokutya, Chittagong, Barapany, and Kokrajhar.

United Provinces.—Aonlakhera, Mailani, Bahramghat, Hardwar, Jugadheri, and Dakpathar.

Central Provinces.—Kotah and Ellichpur, Ghatara, Bagra, Mandh, Gangejhari, Rajahmundry, Shahpur, Mesak, Nellah, Pandhar Nallah, and Bankri.

Burma.—Thirty-three sites are suitable.

Bombay.—Three factories are at work, the other available sites are Mokhuda, Vasind, Badlapur, Ramraj, Patanse, Kamaril, Karjat, Apta, or Chavna Navapur, Khandbara, Taloda, Raver, Sawda, Chopra, Shirpur, Satara District, Dodkop, Mangalwedhe, Sorwalli, Arbail, Sirsi, Siddapur, etc., Kudra, Santaped, Marekal, Gairsoppa.

Madras.—Rosulkonda, Narsapatnam, Kistanadeviped, Rajahmundry, Samalkota, Kondapalli, Bandlapenta, Telli-chery, Calicut and Udamalpet.

11. A new set of rules has been framed in supercession of the old ones for the Indian Government Technical Scholars proceeding to England. The Rules are issued as an accom-

paniment to Government notification dated 10th December 1910, directing the students to avail themselves of the information and advice of the educational advisers.

12. Mr. William Raitt, the fibre expert, who was working at the Allahabad Exhibition has been placed on special duty at the Forest Research Institute, Dehra Dun, to investigate the question of utilization of wood pulp for paper manufacture and starting wood-pulp Factories.

13. The Government of India Scholarship tenable in Europe for the domiciled Europeans and Eurasians has been awarded to Mr. Richard Sidney Blaker, nominated by the Punjab Government.

14. The Government of India Resolution on the working of Co-operative Credit Societies Act during the year 1909-10, shows that the idea of Co-operation is fast gaining ground and is spreading all over the country. The total No. of Societies at the end of the year was 3,498 or 3,500 showing an increase of nearly 14 per cent. over last year's figures. The number of members increased from 184,889 to 231,000 and the capital from Rs. 80,65,111 to Rs. 1,24,00,000. These results appear to be very encouraging.

15. A Conference of the Registrars of Co-operative Credit Societies in the whole of India, was held at Allahabad in January last. It was attended by the Registrars from all provinces except Burma and by a number of non-official visitors. Reports submitted at the Conference showed that there was a diversity in the lines and methods of development as followed in the different provinces and the opportunity for an interchange of views afforded by this Conference, are bound to be very useful to those who are engaged in the work.

16. Mr. Maxwell Lefroy, M. A., late Imperial Entomologist, has compiled as the result of his labours at Pusa, a valuable pamphlet on "Mixtures, and Ripes for use against insects in the Fields, the orchard, the Garden and the House."

17. Mr. G. A. Gammie, the Imperial Cotton Specialist is

engaged in investigating the cottons of the Central Provinces, Central India, Gujarat, Kathiawar and the Southern Mahratta country.

18. The Government of India Scholar Mr. K. G. Bhat, L.M.T., who proceeded to England, after he had qualified himself as a Licentiate in Textile manufacture at the Victoria Jubilee Technical Institute, Bombay, has now returned to India, after a three years' course in the Municipal School of Technology in Manchester, giving special attention to weaving, dyeing, bleaching and finishing.

BOMBAY.

19. The Bombay Government have announced their decision to retain for a further period of six years, the special establishment employed under the Director of Agriculture of the Bombay Presidency for the continuance of the well-boring experiments in the Presidency.

20. The Governor-in-Council, Bombay, has decided that commencing from the 1st November 1911, the College of Science should confine its courses to Civil and Mechanical Engineering only, except in respect of the work-shop course which comprises Electrical Engineering as one of the subjects taught. There will henceforward be no provision for teaching of pure Science except so far as required for Engineering courses. The name of the College will be altered from this date to "College of Engineering."

21. During the year under review, agricultural classes for the benefit of sons of farmers were opened in connection with the agricultural College, Poona, for training the students (1) in the improved processes of growing sugarcane, extraction of juice and preparation of gul and (2) in Dairy industry. This is indeed a step in the right direction and deserves to be followed up by similar provision being made in the other Provinces as well.

22. Important additions have been made recently to the Agricultural College of Poona. The new buildings will be uti-

lized for locating the chemical and physical laboratories of the College. It will also accommodate the office of the Professor of Agriculture, and the Zoological laboratory. The opening ceremony of the new block was performed by Sir George Clarke, the Governor of Bombay on 18th July last, in the presence of a large and representative gathering, when His Excellency took a bird's-eye-view of the work done by the Agricultural College since its foundation, and the great progress made in the diffusion of agricultural education in the Presidency in recent years. During last year, 17 Agricultural Exhibitions, 29 practical demonstrations were held and 12 new agricultural associations formed at different places. These figures amply testify to the useful work of the Agricultural Department.

23. The Government of Bombay have issued a press note on condition the Sugar industry of the Presidency, and the difficulties in the way of its expansion with the object of inviting public discussion on the question of devising measures for continuing the work commenced by Government, and of expanding the same to suit the requirements of this important industry.

24. The Bombay Provincial Co-operative Conference was opened on the 24th June last by His Excellency, Sir George Clarke, the Governor of Bombay, His Excellency assured the Conference of the anxiety of the Government to further their objects and also announced that the scheme for a Central Bank submitted by Sir Vithaldas Thakersey and the Honorable Mr. Lallubhai Samaldas was progressing well.

25. His Excellency Sir G. Clarke who has been taking a genuine interest in Glass Factory of Talegaon, near Poona, visited the Factory on the 20th of June last, accompanied by Lady Clarke, and expressed his great satisfaction with the work of the Factory. The institution has already won gold and silver medals at several Exhibitions. More than Rs. 22,000 have been spent, in the construction of buildings, equipment of a laboratory for the teaching of the general principles of chemistry, physics, geology and special chemis-

try of glass and allied industries such as enamelling and Chinaware are taught by a qualified Professor.

26. The Government of India have ruled that when stores are purchased by a Government Department articles made in India shall always be preferred to imported articles provided their quality is satisfactory and their price not unfavourable. In the opinion of the Bombay Government this rule is not strictly observed by subordinate officials when submitting Indents on the Store Department of the India Office. The Bombay Government have ordered that when any purchases are to be made in small as well as in large quantities it must first be ascertained whether suitable articles of country-make are obtainable. The imported articles should be purchased only when indigenous articles are not available.

27. From the Press note dated 20th April last issued by the Bombay Government the following information is culled for the benefit of those who are interested in the advancement of the study of sciences in Schools. *The Note* contains in a tabular form, extracts from the Report of the Committee appointed by the Syndicate of the Bombay University as well as the action taken by Government :—

(1) In reply to the complaint of the Committee that no adequate accommodation is provided in the Elphinstone College, Bombay, for teaching of Physics and Chemistry, Government has given the assurance that science teaching will be placed on an efficient footing when it is concentrated in the Institute of Science.

(2) In regard to a similar difficulty experienced in the Deccan College, Poona, Government of Bombay has promised to consider what science courses should be taught in that College when revising Curricula for arts and science, and to take steps to ensure efficient instruction in science.

(3) A new Engineering Laboratory provided with the latest types of plant for the testing of materials, &c., is shortly to be added to the College of Engineering, Poona. The want of such a laboratory was keenly felt and steps are being

taken to provide an adequate laboratory. With regard to the question of providing for the teaching of Geology in this College, Sir T. H. Holland, late Director, Geological Survey of India, was consulted by Government and in his opinion a geological professor imported from Europe would not be suitable as the geological systems of this country are distinct from those taught in Europe. For this reason, an officer of the geological survey department will be deputed to the College from June to September each year for teaching geology. Last year the deputation of the officer was extended up to December to enable him to complete the arrangement and cataloguing of the new geological museum.

28. The Bombay Government has invited applications for one or two state technical scholarships from candidates in the Bombay Presidency for a course of training in (1) Oil pressing and refining with special reference to cotton seed oil and (2) manufacture of tanning extracts and their use in tanning.

29. The Bombay Government have recently issued orders on the Report of the Director of Public Instruction on the Examinations of the London Chamber of Commerce in commercial Education. The Resolution emphasises the desirability of declaring the results at an earlier date, if possible by the middle of July every year, at the latest. The increasing number of candidates for these examinations is a sign of the growing popularity of these courses.

30. The Bombay Government have issued a Resolution, in connection with the Pottery department of the Sir J. J. School of Art in which they point out the necessity on the part of the school authorities of demonstrating to the public, that with a complete installation of up-to-date machinery it is possible to manufacture plates, cups, tiles and other articles of pottery and earthenware, which are now largely imported into India from foreign countries. In order to encourage the pottery industry, as far as possible, the Bombay Government have decided that the results of the experiments in the pottery department of this School should be

made available to the public free of charge. The Principal has accordingly been instructed to invite requests for expert advice from private firms and individuals who are interested in the industry.

81. The necessity of standardization of weights and measures which the Industrial Conference has been trying to impress on Imperial as well as Provincial Governments year after year, is being slowly recognised. The Bombay Government in their Resolution of March last, distinctly acknowledge that "the diversity in weights and measures in use not only in different districts of the Presidency but also in different towns in the same district and even in different parts of the same town" is an evil which creates an element of uncertainty in trade, renders fraud on the part of retailers easy and profitable. To avoid this inconvenience to trade the Government has appointed a committee, to whom the following questions are referred for investigation and report :—

(a) Is it desirable that standardization of weights and measures should be undertaken ? and, if so,

(b) What weights and measures should be dealt with ?

(c) What districts or localities should first be brought to standard.

(d) What steps should Government take to bring about the object in view ?

82. The Agricultural College completed its second year as a separate institution and its work is being conducted under very favourable conditions. A strong desire having been expressed at the Agricultural Conference of 1909, that the benefits of scientific training in agriculture should be brought within the reach of the sons of cultivators and others who cannot take advantage of the regular course, a vernacular school has been specially started for their benefit. This class has made an excellent start.

83. One of the most tangible results of the public spirit and princely munificence of some of the Bombay mill-owners, has been the establishment of the Central Institute of Science at

Bombay. The ceremony of laying the foundation stone of this Institute was performed in March last, by His Excellency, Sir George Clarke, the Governor of Bombay. The donors, *viz.*, Sir Jacob Sassoon, Sir Currimboy Ebrahim, and Sir Cowasji Jehangir are well known mill-owners of Bombay. The Institute will have three storeys; the ground will be devoted to Physics Department, the second storey will be given to chemistry and the third to Botany, Geology and Zoology. There will be 2 lecture Halls. Each department will have a museum of its own and the Institute will include professors' rooms, laboratories for elementary and advanced instruction and for research and experimental work.

34. It appears from the resolution issued by the Bombay Government on the annual report of the Department of Agriculture, that substantial progress has been made by the department in all important branches, especially in bringing home to the cultivators a knowledge of the results attained and the means of applying them in practice. Agricultural Associations are being formed in all parts of the Presidency the total number being 31, including 12 established during the year under review. The most important one is the Deccan Agricultural Association, which supplements the departmental bulletins by the issue of a vernacular monthly devoted to agricultural subjects.

35. The Bombay Government have issued a resolution directing all departments under them to purchase as far as possible articles manufactured at the Paisa Fund Glass Works, Talegaon near Poona and have granted permission to the factory for the removal of quartz free of charge from the forest and Government waste lands in the Mawal Taluq of the Poona District. The Indian States of Baroda and Hyderabad have also issued instructions to their department to patronize the products of this glass factory.

36. It appears from the Forest Administration Report of the Bombay Presidency that the experiments in rubber cultivation are not encouraging, and the department has come

to the conclusion that there are no chances of success in that enterprise in the presidency.

37. The proposal made by the Deputy Conservator of Forests, Sind circle to place an officer on special duty to extend the production of lac in Sind is likely to be taken up and trials will be made in this direction in East Khandesh also.

MADRAS

38. The Honorary Director of Fisheries to the Government of Madras has sent a few samples of fish oil made at Cannanore to some Jute Mills of Calcutta for being tested if they were fit for batching purposes, and the samples on trial were found quite satisfactory for this purpose. This industry has thus a large field for expansion.

39. At a meeting of the Madras Legislative Council on 23rd February last, the Honourable Mr. Seshagiri Iyer voiced the popular opinion of the Presidency when he protested against the decision of the Secretary of State for India, ordering the abolition of the Department of Industries, which was doing very valuable work, pointing out that pioneering of industries was one of the duties of an enlightened State.

40. The experiments in growing superior varieties of cotton, in the Madras Presidency under the auspices of the Government agricultural department have proved to be very successful. The value of this crop is now being realised in many places in the Presidency, two ginning factories having lately been opened in two localities on account of the fine quality of the "Karun ganni" cotton now obtainable.

41. The Government of Madras has appointed a "Tinctorial" expert for the purpose of developing the dyeing industry of Southern India. His report is nearly ready and will be submitted to Government within a few months. Mr. W. Coombes who has been investigating the dyeing industry of the Madras Presidency has supplied some interesting information. In Madura and other centres of the industry about 11,000 cwts. of alizarine valued at £35,000

was used last year, in place of Madder which was used formerly by Indian dyers. According to Mr. Coombes the methods of these dyers are extremely primitive and wasteful and the Madras Government intend therefore, to erect a model dye-house where instruction in modern processes will be given.

42. The Madras Government chrome tannery at Sembium has been closed and the whole concern handed over to the Rewah State which is now carrying on the work at Perambore.

43. The Madras Government has recently created the new post of Superintendent of Industrial Education and appointed the Hon'ble Mr. Alfred Chatterton, late Director of Industries to fill the same.

44. The Government of Madras have notified that a State Technical Scholarship of £150 per year will be awarded during the year for the study of weaving in Great Britain or with the approval of the Secretary of State in a foreign country.

45. There is every likelihood that the project for making the water of the Periyar available for the generation of power will soon be revived and assume some definite shape. The Report on this question submitted by the late Director of Industries, is very encouraging.

46. It appears from a press note issued by the Director of Agriculture, Madras, that the cultivation of the Cambodia or American cotton has been very successful in the Tinnevely, Madura and Trichinopoly Districts. It is also announced that seed can be obtained from the Deputy Director of Agriculture, Trichinopoly at 9 pies per lb. exclusive of packing and other charges; about 10lbs. of seed are required per acre and a leaflet describing the process of cultivation in Tamil, Telugu and English accompanies each consignment.

47. An extension of the Boiler Shop at the Perambore Works, Madras, has been sanctioned together with its equipment with hydraulic plant as the riveting of the Boilers of the new type of Engines, requires the use of such plant.

48. The Madras Government appointed a Committee to enquire and report on the subject of the supply of green leaf manure to the ryots. The Committee consisted of the Conservator and Deputy Conservator of Forests and Director and Deputy Director of Agriculture of the Madura District. The Committee has decided that forest department should in future produce and supply seed for green manure plants. Madras Government has accepted the resolution and it will be made applicable to the whole Presidency. Much better crops will, it is expected be raised with green manuring crops cultivated on the land itself and ploughed into the soil.

BENGAL

49. The Eri Silk cultivation work has been successfully carried through all the stages at Pusa from the hatching of the eggs and rearing of the worms to the weaving of the cloth. The demand for eggs from all parts of India has been far in excess of the supply and this industry has already spread to various places in Madras Presidency.

50. The ceremony of distributing diplomas to the students of the Government School at Serampore took place on 26th July last. Out of 18 students who appeared for the Examination, 12 had passed, 6 of the higher class students found employment immediately, and the others commenced starting a hand loom factory. This School is largely availed of by the weavers of Serampore of whom nearly 100 have already passed through.

51. The Department of Agriculture, Bengal, is conducting a series of experiments with the thornless cactus, in view of its being used for fodder for cattle. Several varieties were imported from Southern Europe and California and are under trial.

BEHAR

52. Experiments are being conducted in Behar for the last three years in the cultivation of flax under the supervision of a Belgian expert. The trials are promising and deserve to be taken up by the Behar Planters' Association.

EASTERN BENGAL AND ASSAM

53. Mr. R. S. Finlow, the Jute Specialist to the Government of Eastern Bengal has detected in South Eastern Mymensing a new variety of the common round podded jute plant called "banput" in Vernacular. This plant is now being grown under observation at the Dacca Experimental Farm.

54. It appears from the Annual Report of the Agricultural Department that the trials for growing and curing Sumatra tobacco in these provinces have proved very successful. The curing is done in specially constructed sheds, with arrangements to regulate moisture and heat. Almost the whole of the Sumatra tobacco grown by the Department last year was purchased by some European firms of Cigar manufacturers at Trichinopoly at prices ranging from Rs. 35 to Rs. 60 per maund whereas the actual cost of production amounted to only about Rs. 14 per maund. Two varieties of American tobacco well suited for the manufacture of Cigarettes have also given a fair yield.

PUNJAB

55. An Industrial Conference was held at Lahore in February last, under the auspices of the Lieutenant-Governor of the Punjab for the discussion of industrial and economic questions. The Resolutions passed by the Conference will be found reproduced elsewhere.

56. The Punjab Agricultural College, Lyallpur was formally opened in December last by His Honor Sir Louis Dane, the Lieutenant-Governor. There is also a research institute attached to the College, and an endeavour is made there to combine theory and practice with the aid of laboratories equipped on most advanced lines.

57. The Punjab Government has selected cotton seed oil milling and refining as the industry for which a Technical scholarship of £150 a year is to be awarded. This subject

includes a practical knowledge of manufacture of butter substitutes and the utilization of bye-products.

58. Auctions were as usual held last year by the Punjab Agricultural Department of American cotton grown on Government farms of the Province, and the prices realised were about one Rupee per maund over the rates for *desi* cotton. Fresh seed is being obtained from Dharwar, and other steps taken for the improvements in cotton cultivation.

59. The Punjab Forest Department has completed the buildings necessary for the manufacture of turpentine and resin on the banks of the Ravi River, and has started distillation on an experimental scale. The industry when fully developed is calculated to produce about 40,000 gallons of turpentine and 17,000 maunds of resin per year. These quantities roughly represent only one-fifth of the Indian demand.

60. For the spread of Scientific and Technical Education in the Punjab, His Honor Sir Louis Dane has sanctioned an annual grant of Rs. 200 to the science institute there.

61. The Imperial cotton specialist has been detailed in the Punjab for the purpose of reporting on the work done for improvement of cotton. He will continue his study of Bourbon and Buri varieties in non-cotton-producing tracts. The question of the distribution of seeds of improved varieties will be further discussed in Bombay and the Central Provinces.

62. Sir Louis Dane Weaving School for the Punjab which has been in existence for the last 8 years, is doing extremely valuable work under the management of the Salvation Army. This School has manufactured more than 800 improved handlooms to meet the demand from several places in India, East Africa, Ceylon and the Straits Settlements. At the Ludhiana School 97 students received their training in the last year, most of them being drawn from the weaver classes. The Salvation Army has also taken in hand the making of improved warping machines, and the starting of an agency to place the products of the School in the world's markets.

63. Deficiency of labour and hardness of the soil, has

forced the Irrigation Department of the Punjab, to import recently two Mechanical excavators for work on the Upper Chenaub Canal. The first of these Machines is being erected on the Chichoki—Malbon section. The use of these excavators, it is surmised, will tackle the problem of shortage of labour in the Punjab. One excavator is estimated to do the work of 600 men. The cost of excavating 1,000 cubic feet of earth by human labour is about Rs. 10 whereas the excavator can do the same quantity of work for Rs. 3 including all charges.

CENTRAL PROVINCES

64. An important scheme for the revival and preservation of home industries in the Central Provinces, has been submitted by the local administration to the Government of India.

65. From the information collected by Mr. E. Batchelor, I.C.S., Officiating Deputy Commissioner, Bilaspur, it appears that there are a few sources of water in C. P. lying yet unnoticed and undeveloped. One of them, is situated on the Chorni River in the Janjgir tahsil, at a distance of 45 miles from Champa Railway Station on the B. N. Railway. Making due allowance for the irregularity of rainfall this source is likely to develop about 8000 H. P. at least for four months of the year.

UNITED PROVINCES

66. Mr. W. R. Wilson, B. Sc., Director of Industries, United Provinces is greatly interesting himself in the expansion of industry, and is ready to furnish information on this subject to all who are interested in it.

67. The modified scheme for the establishment of a Technological Institute at Cawnpore, proposed by the Government of the United Provinces has recently been sanctioned by the Secretary of State for India. It may be within the recollection of the readers that the original scheme was put forward in 1907 on the recommendation of the Naini Tal Industrial Conference. The scheme as at present sanctioned admits of

further expansion. A chemist will be employed to carry on the work of research and the training of students. A scientific library will be attached to this institute.

68. A course of instruction was opened in the Hewett Weaving School, Bara Banki from August 1911, for training in the completion and finish of knitted cotton and silk hosiery. Students should go through the course for at least one month in order to gain a full knowledge. No fees will be charged for the course.

69. The United Provinces Government has invited applications for two technical scholarships of £ 150 each tenable for two years in England or other western countries for instruction in the manufacture of sugar, vegetable oils, mechanical engineering, electrical engineering, or manufacture of paper.

70. The Director of Land Records and Agriculture, United Provinces, at Lucknow has opened a list of recognised machinery dealers having establishments or agencies in the Provinces, and it is also stated that preference will be given to firms on this list.

71. To afford better facilities for the study of Textile Industry in the Thomason College, the Government have decided to lower the educational standard of the students desirous of joining this course. All candidates will be nominated by the Committee of management and only those will be selected who in their opinion are likely to profit by their College training. Facilities will also be given to students wishing to enter the Electrical and Mechanical Engineering Sections of the College.

72. The following technical schools have been established in the United Provinces ; at Bareilly for Carpentry ; at Lucknow and Gorakhpur for engineering and general technical education, at Benares for weaving design improvements and manufacturing processes, at Lucknow for art designs. There are also weaving Schools purely for weavers at Bara Banki Tanda, Deoband, Muzaffar Nagar, Morada-

bad, Sandila and Almora as well as others managed by private bodies.

73. The United Provinces Exhibition held at Allahabad at the beginning of the year, under the auspices of the Government was certainly a very imposing show. We regret within the circumscribed limits of an annual report we cannot do adequate justice to it.

The Exhibition was divided into the following Courts :—

- (1) Textile Court.
- (2) Ladies' Court.
- (3) Municipal and Hygiene Court.
- (4) General Industries Court.
- (5) Wood, Stone and Metal Court.
- (6) Photo Salon Court.
- (7) Fine and Applied Arts Court.
- (8) Native States and Jipur Courts.
- (9) Engineering Court.
- (10) Agricultural Court.
- (11) Roorkee College, and Miscellaneous Courts.

Apart from the thousand and one articles representing indigenous arts and industries of the U. P. and other Provinces in British Indian and the Indian States, there were also some excellent and useful models of agricultural and other kinds of Machinery which deserve to be tried and introduced into the country.

BURMA

74. The agricultural department is examining the value of paddy husk as manure. The inquiry is being conducted in parts of Pyintha Township, Maymyo subdivision.

75. The source, supply and the agricultural value of the canal and river silt of Burma also form the subject of another investigation by the agricultural department.

MYSORE

76. Another evidence, if any is needed at all, of the progressive spirit of the Mysore State may be found in the pro-

ceedings of the first Mysore Advisory Conference which assembled on 10th June last under the Presidency of H. H. the Maharaja, whose remarks on economical problems, made in the course of his highly learned and comprehensive address are well worth a careful study.

77. The Mysore Dessarah Industrial and Agricultural Exhibition was opened in September last by the Yuvaraj in the presence of a large gathering. This year a more organised attempt was made to encourage visitors belonging to the agriculturist and artisan classes, and to promote competition among them. The Electrical Section of the Exhibition contained a most ingenious model of the Cauvery Power Works from the transformer houses at the Falls and at the Kolar Goldfields to an electric Bath Chamber and an electrically illuminated Tower. The Forestry and Machinery sections also were unusually interesting.

BARODA

78. The industrial activity of the Baroda State may be summed up in a few words thus :—

(1) Gaekwar sugar works which were sold in 1905-06 to a private concern were overhauled and refitted at considerable expense, and started the manufacture of fine sugar from jaggery during the past year. This company has also commenced the manufacture of jaggery from palm juice.

(2) The Chocolate Factory at Bilimora which was handicapped for a time for want of capital started work towards the end of last year.

(3) Arrangements are in progress for starting a Glass Factory at Baroda.

(4) In regard to China clay deposits which have been discovered in some districts detailed experiments are being made.

79. A very valuable and informing report has been compiled on "The Mineral Resources of the Baroda State" by Mr. V. S. Sambasiva Iyer, B. Sc., whose services were lent by the Mysore Government for a systematic Geological

Survey of the Baroda State. The report discloses the fact that the territories of H. H. the Maharaja Gaekwar abound with several useful minerals, which await development on a commercial basis :—

- (1) The ceramic clay
- (2) Quartz-sand.
- (3) Cement materials.
- (4) Natural soda.
- (5) Salt.
- (6) Agates.
- (7) Green marble.
- (8) Sand stones for Glass making.

80. The enlightened ruler of the Baroda State, we mean His Highness the Gaekwar, is already well-known over the length and breadth of India, for the many-sided reforms that he has successfully introduced into his model State. His latest effort for the diffusion of general as well as scientific education amongst the residents of his capital *viz.*, Baroda and his subjects in the mofussil is assuming a definite shape since the establishment of the Central Library Department. This department which is recently formed is being organized by Mr. W. A. Barden, an American expert specially secured by the Maharaja during his travels in America. This institution starts its work with a collection of 238,000 Books, of which the number of scientific books alone is 90,000. It aims at providing facilities to the residents of Baroda of a free library and a reading room. Over two hundred books are issued daily on loan free of charge, about one hundred sets consisting of 20 to 25 books are ready for being sent out to the different places in the Maharaja's dominions, that the people may reap the advantages of a travelling Library. The collection of scientific literature appears to be sufficiently comprehensive from the number of books already stocked and deserves to be resorted to by all who take any interest in technical literature. The collection of scientific books supplies a distinct want.

TRAVANCORE.

81. Mr. Ram Rau Garu, the Conservator of Forest of the State has compiled a note on the prospects of establishing match factories in Southern India.

82. There is a project for the opening of a Training College at Trivandrum. The building for the College is ready and orders have been issued to the Chief Engineer to submit estimates for the building for the science laboratory and manual training. The College will start work on a modest scale but the very fact that training applied science and manual works forms part of its curriculum is significant.

GWALIOR

83. The Department of Commerce and Industry in Gwalior has opened a Technical Weaving School at Chanderi for the fostering of the weaving trade for which the place is noted. The State Glass Factory at Morar has been taken over by a private firm.

BHAVNAGAR

84. To advance the prosperity of the State, a special committee has been appointed by the Durbar authorities to tour through the different parts of the State and to collect the views of the experts on matters relating to its economical, agricultural and industrial condition.

FARIDKOT

85. In connection with the marriage festivities of the minor Raja, Granaries with elevators were opened by the Lieut. Governor of the Province, along with other social reforms introduced by the Durbar.

COCHIN

86. An Industrial and Economic Survey of the State was conducted by Mr. C. Achyuta Menon and the exhaustive report submitted by him, shows that there is much industrial activity in the State. The Durbar is anxious to promote technical education, and to develop textile, Fibre oil and oilseed and metal working industries.

PART II

Section B.

INDUSTRIAL ACTIVITY OF THE PEOPLE.

GENERAL

1. Colonel C. H. Bedford, M. D., I. M. S., late Chemical Examiner and Bacteriologist, Burma, has decided to make a munificent bequest (from the date of the death of himself or his wife, whoever may be the survivor) of a sum of several thousands of pounds for the endowment of two or three scholarships and to provide the necessary funds for the prosecution of scientific and technical research in connection with the development of Indian industries.

BOMBAY

2. The Honorable Sir Sassoon David, member of the Viceregal Council and the well-known Bombay mill-owner has placed a princely sum of 8 lakhs and 4,000 rupees at the disposal of the Bombay Government to commemorate the historic visit of their Imperial Majesties the King Emperor and Queen Empress to Indian shores for Coronation. The interest of this sum is to be utilized for the education of the agriculturists in villages, for agricultural experiments and researches and several other useful purposes.

3. Efforts are being made in the Poona District and other parts of the Bombay Presidency for the cultivation and propagation of lac, both by Government departments and non-official gentlemen.

4. Rao Sahib Vasanji Trikanji, J. P., a well-known cotton merchant of Bombay has given 2½ lakhs of rupees for a scientific Library to be attached to the Bombay Science Institute. The total donations for the Institute, including

Government contribution as well as the gift of Rao Saheb Vasanji now amount to Rs. 31½ lakhs.

5. A special resolution was passed in July last at an extraordinary general meeting of the Madhavji Dharamsi Manufacturing Co. of Bombay, for raising the capital of the mill to 15 lakhs of rupees, divided into 600 additional ordinary shares.

6. "The commercial academy" is the name of an institution opened at 65, Hornby Road, Bombay, for a course of short-hand, type-writing, Book-keeping and other subjects appertaining to commercial education. The proprietors of this institution have announced their intention to take twelve free students, viz. 3 Christians, 3 Gujeratis, 3 Mahratta Hindus, and 3 Parsees.

7. The scheme for the establishment of an agricultural Bank formulated by the Hon'ble Sir Vithaldas D. Thackersey and the Hon'ble Mr. Lalubhai Samaldas of Bombay has been sanctioned by the Secretary of State for India in a modified form. The main features of this scheme, are that the State should guarantee the interest on debentures to the amount of four times the capital of the bank; that the bank be empowered to lend money to the co-operative credit societies at 7 per cent and that the Government should have the right of inspecting the books of the bank and to appoint its own audit-officers, if deemed necessary.

8. Mr. H. K. Dikshit has qualified himself for the post of a manager in an Indian Factory. After completing his course of study in the Manchester Municipal School of Technology where he obtained a diploma in the Textile industries, he has also gained high class certificates of competency from the Victoria University of Manchester and other institutions.

9. The Resident Engineer of the Tata Iron Works, who has been working at Kalimati for the last three years is reported to have completed his work and the plant is ready to commence operations.

10. The progress of the Tata Iron Works at Kallmati, is reported to be very satisfactory. One hundred thousand tons of Iron ore are ready for despatch to Kalimati a distance of 40 miles from the pit. A special Railway line is being built by Government and will cover a distance of 50 miles. The Company can obtain coal in any desired quantities from its own mines. The Manganese mines have produced so far nearly 20,000 tons of Manganese ore, which has already been sold and exported to Europe. Furnaces, shop-buildings, Company's own siding at Kalimati etc. are nearly ready. The River dam for the water supply and the reservoirs have been built, workshops fitted up in the most up-to-date style. The year 1911 will thus witness the completion of the works.

11. The Bharatkhand Textile Mill Co. of Ahmedabad has ordered during the year, 250 looms with the necessary preparatory machinery and the Victoria Mills, Bombay 500 looms.

12. Sirdar Sir Chinubhai Madhavlal, C.I.E. has made a donation to Government of Bombay, of 2 lakhs of rupees in $3\frac{1}{2}$ per cent Government paper to meet the cost of the buildings for the Madhavlal Ranchodlal Science Institute, Ahmedabad in addition to the original endowment of 4 lakhs.

13. The work of the Tata Hydro Electric Power Supply Co., Ltd. is making rapid progress under direction of Mr. Alfred Dickinson, Consulting Engineer. The works at Walwhan and Lonavla lakes when completed are estimated to develop a capacity of 2560 and 378 cubic feet respectively at a height of 2070 ft. from the sea level. The energy delivered in Bombay will be equal to 30,000 I. H. P. The Power Station will be thus larger than any hitherto put up in this country. The inauguration ceremony of the works was performed at Lonavla on 8th February last, by His Excellency Sir George Clarke, Governor of Bombay, in the presence of a large and influential gathering including H. H. the Maharaja of Mysore and other notable guests. The proceedings were opened by Sir Dorabjee Tata in an address reviewing the history of the whole scheme from its inception.

The speech made by H. E. Sir George Clarke after laying the foundation was very impressive and informing and we make no apology in quoting a few passages from the concluding remarks of His Excellency :—

"I have alluded to the hygienic and æsthetic importance to the City of Bombay of the introduction of electric power on a large scale, but many other consequences will follow, the indirect effects of which on the life of the people are incalculable, * * * Electric power lends itself perfectly to minute sub-division and thus to the development of a host of small industries which would add to the activities of Bombay."

14. The Runchodlal Chotalal Technical School at Ahmedabad commenced its operations at the beginning of the year. The courses taught in this school are closely connected with the local cotton industry and with its fine equipment and a capable staff of teachers bids fair to prove a highly successful institution. Out of nearly 800 candidates who had sent in their applications, only 77 were admitted in the following branches:

Mechanical Engineering 50.

Spinning 16.

Weaving 11.

15. Messrs. E. R. and F. Turner of Ipswich in England, who are represented in India by Messrs. Greaves, Cotton & Co. of Bombay have erected a plant for the India Flour Mills Ltd., Karachi, capable of turning out 30 to 40 English sacks of flour per hour.

16. The Kathiawad and Ahmedabad Banking Corporation Ltd., is the title of a new bank started in December last at Ahmedabad. The authorized capital of the Company is Rs. 2 lakhs divided into shares of Rs. 10 each. The bank has opened branches at many important towns in India.

17. The academy of Fine Arts is the name of an institution started in Vidyarambhai's Wadi, Thukordwar Road, Bombay under the auspices of a society of prominent Indian artists of Bombay, and under the guidance of Mr. S. R. Harpanhalli. It affords every facility to new as well as advanc-

ed students pursuing their studies in the highest branches of painting, drawing, sculpture &c. The Institute is divided into two classes, the senior and the junior.

18. An Agricultural Exhibition and cattle show was held at Panwel in December 1910. This Exhibition was the third of its kind held in connection with the annual religious fair, and under the auspices of the local agricultural association established in 1908. The number of agricultural exhibits and cattle collected for this show was much larger than in any previous year. There were about 800 samples of rice alone out of nearly 1,000 Exhibits of agricultural products. The Forest department had also co-operated in the organization of this show by sending various kinds of forest products.

19. There was also machinery at the Panwel Exhibition for extraction of plantain fibre, reeling Endi Silk etc. Demonstration of ploughs of improved type and other agricultural machines formed an important feature. Papers on agricultural subjects were read by Mr. G. K. Kelkar and others of the agricultural department.

20. An Agricultural Exhibition was held at Sholapur in January last. It was opened by the Collector of the District, and an inaugural address was delivered by Mr. G. F. Keatinge, Director of Agriculture, Bombay Presidency which was full of useful information to practical agriculturists. Papers on co-operative credit work, cattle diseases, cattle rearing and management, and other kindred subjects were read. There was a large collection of agricultural products, implements and machinery with practical demonstrations. The water finder belonging to the Bombay agricultural department was specially sent by Dr. Mann, the Principal of the Poona Agricultural College and was kept on view.

21. Cattle shows and Agricultural Exhibitions were held also at the following places in the Bombay Presidency during the year :—

(1) Belgaum

(2) Virangon and Sanand in Gujarat

- (3) Shirhatti.
- (4) Hoskaratti (cattle fair).
- (5) Jat (Cattle fair).
- (6) Chinchli (Cattle fair) Kolkapur State.
- (7) Parner.
- (8) Vassoli near pen (Colaba District).

22. The agricultural association of Ahmednagar organized a series of popular lectures in Marathi, for the purpose of explaining to the farmers in a simple language their duties to themselves, and to the State and for giving to them a few practical hints on farming and kindred matters.

23. The New Power Station of the Bombay Tramways and Electric Supply Co., occupies a prominent place among the electric installations started in this country. This station is situated between the city of Bombay on the South and the industrial area of the island on the North. To provide against the deficiency of water supply, Kassara Basin has been deepened that it may form a permanent reservoir of about 5 million gallons.

24. At every annual session of the Indian Industrial Conference, a resolution is passed emphasising the importance of Commercial education and exhorting the Indian Universities to create faculties of commerce and institute degrees in commerce. It is, therefore, very gratifying to the Conference, that a Memorial, was addressed recently by the Chairman of the Indian Merchants' Chamber and Bureau, Bombay, to the Registrar of the Bombay University requesting the authorities to introduce a commercial course for the acquisition of training in higher branches of commerce and also to establish a faculty of commerce.

25. A Company under the title of "Hind Lights" is started at Bombay for the manufacture of Lamps, burners and other lamp accessories.

26. "Arab steamers" is the name of a new Navigation Company floated at Bombay with a nominal capital of 10 lakhs.

27. Union Hosiery and Manufacturing Co., has been established at Bombay with a capital of 2½ lakhs.

28. Indian Finance Corporation, has been formed at Bombay with 5 lakhs as nominal capital.

29. Bombay Cattle breeding and Milk Supply Co., is organized at Bombay for breeding cattle and supplying milk.

30. The Pioneer Bank is the name of a new bank opened at Bombay, with a nominal capital of 50 lakhs.

MADRAS

31. Lace making industry is progressing very steadily in Dummagudem under the supervision of Mr. Cain. The sales of lace manufactured by the local Christian ladies amounted to about Rs. 3,000 a month, and the effect of this industry has been reported to be very wholesome, as it provides work to the unemployed women of the town and teaches the habits of thrift and industry.

32. An Industrial Conference was held in June last at Vizagapatam under the Presidentship of Mr. V. Jogiah of Berhampore, who delivered a very able and informing address in the course of which Mr. Jogiah advocated among other things the necessity of placing men of integrity and business capacities at the helm of new industrial concerns, before trying to win the faith of investors, who have lost confidence in new schemes, owing to the failures of so many companies, and of starting central banks fed by a number of District and Urban Banks.

33. Two new mills called the "Kaleeshwaree Mills," and "The Mall Mills," the first a spinning and the latter a weaving concern have been opened in the Coimbatore District.

34. Chennai Shri Rama Janopkara Nidhi has been opened at Madras with a nominal capital of about 4 lakhs.

35. Madras B.B.B. Brewery Company is the name of a brewery concern lately started at Madras with a capital of 2½ lakhs.

36. Shri Chittambara Vinayakar Mills have lately been

organized at Madras with a capital of 7 lakhs for spinning and weaving cotton.

37. Godaveri Pencil Company has been established at Cocanada for the manufacture of Pencils. It starts its work with a capital of Rs. 25,000.

BENGAL

38. On the 15th April last, the Executive Committee of the association for the advancement of Scientific and Industrial Education of Indians, gave a party to 48 students going abroad with the scholarships of the institution. Of these students 25 were sent to England, 13 to America, 8 to Japan, and 2 to Germany. Sixty-four youths who had previously gone abroad with the scholarships of this institution have come back and are usefully occupied.

39. Babu Krishna Kumar Mitter, a well-known Rais and managing agent of the Ganesh cloth mills, has taken up the idea of the foundation of a Swadeshi museum for the collection of each and every product of Indian indigenous art and industry. An Industrial Directory in English, Bengali and Hindi devoted to trade and Commerce of India, a bank and a manufacturer's association will be started by this new organisation.

40. There has been lately a rush for Mica mining in the Hazaribagh District of Bengal and especially in the Kodirma reserve forest, and several prospecting licenses and mining bases have recently been granted by the local Government.

41. The Bengal Silk Committee proposes with the approval of the local Government to employ a European expert to carry out experiments in hybridising on modern scientific principles. The Committee intends to undertake a thorough trial during the next five years.

42. On the 7th August last, a Swadeshi Mela or Exhibition of pure indigenous articles was organised at Calcutta. There were about 125 stalls displaying various articles including Murshidabad and Benares silk, mill and hand-loom cloths, dhoties, sarees, boots, pottery ware, scientific apparatus,

Surgical instruments, cutlery, cigarettes. Chemical manufactures including inks, boot-polishes, soaps, etc. over 122 different varieties of articles of Swadeshi industry and art had been sent in for Exhibition.

43. The name of Professor J. C. Bose of the Presidency College, Calcutta is sufficiently known all over India, although his researches may not come strictly within the purview of the so-called industrial activity of the country, yet it would be a sheer injustice, if his fresh triumphs in the domain of higher science were to escape the attention of an organization like the Industrial Conference, which hails the advance of applied and pure science in any part of India. Mr. Bose has lately been carrying on researches in plant life and modes of its activities and with the help of clever Indian artisans, has devised instruments of such precision and delicacy that a plant left inside the cover of the recorder to be periodically excited, will write out the story of its own life, in its own script.

44. The Callianjee Cotton Mill in the name of a new weaving factory started at Serampore for the manufacture of grey (colored bordered) dhoties. The plant is fitted for the present with 204 looms.

45. The Calcutta Dairy Farm, Ltd., is the name of a new Bengalee venture started at 30, Harrison Road. The Company starts with a capital of Rs. 50,000 divided into 5,000 shares of Rs. 10 each. The object of the Company is to supply Calcutta with pure milk, ghee, butter, etc.

46. Bangiya Inland Steam Navigation and Trading Company is the name of a Navigation concern registered at Calcutta, with a nominal capital of one lakh.

47. To conduct life assurance business, the Capital Assurance Company has been formed at Calcutta with a capital of 10 lakhs.

48. Empire Flour Mills Co., has been formed at Calcutta with a capital of about 4 lakhs of rupees.

49. Bank of Behar is the name of a new bank floated in Bengal with a capital of 3 lakhs.

50. With the object of planting and manufacturing rubber and tea, Chulsa (Selangor) Rubber Company is formed at Calcutta.

51. Pothohar Soap Company has been projected at Gujair Khan in Bengal for the manufacture of soaps, candles, etc.

52. Star of India Insurance Co. of Bengal will be started with a capital of 10 lakhs to carry on Life Insurance business.

53. To manufacture tiles, bricks and other pottery articles, Pottery and Stoneware Co., has been projected in Bengal.

54. Eagle Foundry Company is the title of a new concern opened for the manufacture and sale of castings.

EASTERN BENGAL AND ASSAM.

55. For carrying on Insurance, banking and money lending business, the Mahaluxmi Provident and Banking Company has been started at Chittagong with a capital of 5 lakhs.

56. The cultivation and manufacture of tea are the objects of the all India Tea and Trading Company formed at Sylhet with a capital of 10 lakhs of rupees.

57. Model Assurance and Banking Company is started at Chittagong for Banking and money lending business.

58. Koringanj Loan Banking and Agency is formed at Sylhet for banking and money lending business.

59. Bengal Duars Bank is the name of a new Bank which is opened at Jalpaiguri with a nominal capital of 2 lakhs.

60. Pabna Sranta Silphi Hosiery and Banking Company has been started at Pabna with a capital of a lakh of rupees.

PUNJAB.

61. Experimental silk worm rearings are being tried at various parts of the Punjab. Shaik Ghulam Sadiq is continuing his endeavour to establish the industry in Gurdaspur, and has put up a filature at Amritsar. The Salvation Army authorities are endeavouring to utilize the mulberry trees at Changa Manga and are also making trials at Dorabar. Demonstrations are also being held in Sirhind and Jhelum Districts.

62. Popular Assurance Provident Fund and Amritsar Mutual Relief Fund are the names of two insurance companies started with a capital of one lakh each at Rawalpindi and Amritsar respectively.

63. Jullundur Bank has newly been formed at Jullundur for banking business.

64. Edward Soap Manufacturing Co. has been started at Pind Dadan Khan for making soaps of different varieties.

65. For starting a workshop and developing industries, a new company under the title of "Agricultural and Commercial Works" has been formed at Amritsar with a capital of one lakh of rupees.

66. For the manufacture of Sporting goods, Co-operative sport works have been started at Sialkot.

67. Karnal Rubber Company, Karnal is the name of a concern organised for planting rubber and dealing in Guttapercha and other substances.

68. Mutual Banking and Assurance is the name of a new Company which starts its work at Lahore for life assurance and banking business.

69. With a nominal capital of two lakhs of rupees a new concern called the Amritsar Sugar works is started for the manufacture of sugar.

70. Punjab Glass works have been opened at Lahore with a capital of 2 lakhs.

71. To carry on banking business, the Bank of Rajputana and Punjab is formed at Ambala.

72. Northern India Feeder Railway Company is the name of a concern floated at Abhottabad with a capital of 50 lakhs.

73. Indian Exchange bank has been opened at Simla with a capital of 5 lakhs.

UNITED PROVINCES.

74. Dr. A. K. Coomaraswamy's prize of Rs. 250 for the best essay on "Trade guilds in India" has been in part awarded

to Lala Mukundi Lal of the Oxford and Cambridge Hostel, Allahabad.

75. Mr. J. D. High, Mechanical Engineer—No. 2, Club Road, Allahabad, has designed Chulas for burning coal. Their prices vary from Rs. 7 to Rs. 80.

76. The Combined Poultry, Chrysanthemum and Bee show was held at Simla in November last. Although the show was a first attempt it was a distinct success. The Poultry Exhibits were remarkably of a good quality and there was a keen competition. There are two large and thriving poultry farms in Simla conducted on sound principles and on business lines. There was an interesting collection of Bee keeping appliances, the uses of which were explained to the visitors. The local Government has made an arrangement with two influential gentlemen for the preservation and improvement of the Montgomery breed of cows which is fast deteriorating and disappearing.

77. From the annual Report for 1910-11 issued by the authorities of the "Free, Industrial, Technical and Arts National College," Brindaban, it appears that this technical school is doing excellent work. This school was founded by Kunwar Mahendra Pratap Singh, son of the late Raja Har Narayan Singh a wealthy land-owner in the United Provinces who was created a trust yielding an annual income of Rs. 27,000 to be devoted solely to this institution which is entirely independent of Government control or aid. In this school instruction is imparted in the vernacular. Boys who are unable to read or write can also learn a trade suitable to their circumstances. Carpentry, smithy, founding, turning, fitting, carpet-weaving and pottery are the principal arts taught here. It trains also sub-overseers and small contractors, who are completely ignorant. The school is thus useful even to sons of labourers and other people who cannot join the expensive courses.

78. For ginning and manufacturing wool the Ganges Cotton and Flour Mills Company is started at Kankhal with a capital of Rs. 50,000.

79. For making sugar, molasses and Gur a company has been organised at Basti, with a capital of Rs. 5 lakhs.

80. Kanyakubja Mercantile Bank of India is the title of a new Bank opened at Cawnpore with a nominal capital of Rs. 10 lakhs.

81. Through the untiring zeal and perseverance of the Honorable Pandit Madan Mohan Malaviya and Mrs. Besant, the projected scheme for the foundation of the Hindu University is assuming a definite shape.

The University will comprise the following Colleges:—

- (1) A Sanskrit College with a theological department.
- (2) A College of Arts and Literature.
- (3) Do Science and Technology.
- (4) Do Agriculture.
- (5) Do Commerce.
- (6) Do Medicine ; and
- (7) Do Music and fine arts.

The University thus proposes to make provision for the higher branches of technical and commercial education.

82. At Allahabad two new banks are opened under the title of British India Bank with a nominal capital of 2½ lakhs and United India Bank with 5 lakhs respectively.

83. Manufacture of metal and metal goods is the object of Delhi metal works opened recently with a capital of one lakh of Rupees.

CENTRAL PROVINCES.

84. A proposal for the formation of a Co-operative and Finance Bank in connection with the co-operative credit societies established throughout the Central Provinces is under consideration.

85. The old Nagpore Swadeshi mills which have recently been purchased by Messrs. Tata, Sons & Co., are to be rebuilt, refurnished with new machinery to be driven by Electric power generated on the premises. The mill will consist of 30,000 ring spindles and 500 looms driven through-out by electricity.

86. For the supply of electric light and power, the Nagpore Electric Light and Power Company is formed at Nagpur with a capital of 5½ lakhs.

87. Central Provinces Railways Company has been registered at Bombay with a nominal capital of 60 lakhs for opening branch and feeder lines in the C. P.

88. Berar Oil Works is the name of an oil extracting and refining factory established at Akola, through the exertions of the Honourable Rao Bahadur Mudholkar and a few other leading gentlemen of Berar. The cotton seed oil manufactured by this concern is almost colorless and is fit for use in culinary purposes. The boiled linseed oil, cotton seed oil, oil cakes and other products of this mill have been approved by Dr. H. H. Mann, the Agricultural Chemist to the Government of Bombay.

BURMA

89. A new Match Factory has been started at Khananny near Rangoon. The Hon'ble Lim Chin Isong who is the promoter of the concern is reported to have engaged the services of Mr. S.C. Evance, an expert who is reported to possess much European experience in the industry.

90. The Burma Solid Fuel Co., Ltd., has been registered with a capital of £50,000 for manufacturing solid oil fuel in Burma. The Indian oil syndicate which holds patent rights in respect of a process for the solidification of Crude Oils, Benzene &c. has been incorporated with this firm.

91. A company is being formed in Lower Burma for the manufacture of plantain fibre with a capital of 5 lakhs of Rupees divided into 50,000 shares. The first factory has been started at Yanthelon in the Henzada District to be followed by other concerns of the same nature in plantain tracts.

92. Mergui Brown Rubber Estates is the name of a big concern floated at Rangoon, for the cultivation of para rubber, with a nominal capital of 22½ lakhs.

93. Irawaddy Petroleum Oil Syndicate has been

established with a capital of 30 lakhs for working, developing and exploiting Oil bearing lands.

94. For the purposes of exploring, mining for earth oil, minerals etc., in Burma a new company starts its operations at Minbu with a capital of 3 lakhs of Rupees.

95. Burma Boring Company, Pajubue Petroleum Syndicate, and Moolla Oil Company have been lately started at Rangoon for prospecting mineral oils.

96. With the object of carrying on gold dredging and other metallurgical operations, Burma Gold Dredging Co., Ltd., is started at Rangoon with a capital of 10½ lakhs.

97. A New Navigation Company under the title of Chinese Steamship Co., is formed at Rangoon with a capital of 23 lakhs.

98. Mitra Biswas Insurance and Banking Corporation is organized in Bengal with a capital of 10 lakhs.

99. A Dairy Company with the title of City of Calcutta Dairy Company is started at Calcutta with a capital of Rs. 50,000.

100. Pathee Choung Rubber Company is formed at Rangoon having for its object the cultivation of Rubber.

101. Hermyingyi Mining Co., and Sham Uddin Oil Company are the names of two more concerns floated at Rangoon for prospecting, refining etc. of petroleum.

MYSORE

102. The Proprietors of the City General Agency have lately started an "Enterprise Bureau" for imparting instruction to its members by post or by personal tuition on several subjects pertaining to industry, commerce or agency. The admission fee is only Re. 1/- a month which includes a month's tuition. Further instructions are to be paid for separately according to the importance of the subject selected.

103. A new scheme for horticultural experiments has been started in Bilaspur which is close to Bangalore. The promoters of the scheme have laid out an orchard and vine yard on modern scientific methods to conduct

experiments in gardening and the new Estate bids fair to give a "practical demonstration of the fact that seems to need so much reiteration that given a chance, India can give the colonies points almost all along the line."

104. The work of the Bangalore-Chickballapur Railway is reported to be proceeding satisfactorily. His Highness the Maharaja of Mysore has given an impetus to the project by himself becoming a shareholder. The Directors have started construction of this Railway.

MALABAR

105. For planting Tea and Rubber, Eddivanna Rubber and Tea Company is formed at Calicut.

GWALIOR

106. The Gwalior Chamber of Commerce consists of 60 members and has been lately organized for expansion of commerce of the State. There is no want of capital but experience in doing business that had checked the progress of Gwalior merchants in commercial matters. It is hoped the Chamber will greatly improve business prospects.

PATIALA

107. Sirdar Raja Babu, A.D.C. to H. H. the Maharaja of Patiala and the Superintendent Games Department, has contrived a very ingenious device "the automatic collision preventer" to safeguard the life and property of the public. On the 4th Nov. last year, the inventor exhibited the model of his contrivance in full working order in the presence of a large and distinguished gathering including His Hon. Sir Louis Dane, the Lt. Governor of the Punjab and hundreds of European and Indian guests, to the full satisfaction of those present. The model was also worked before the Railway Conference, Simla, and deserves every success.

BHAVNAGAR

108. In May last, Sir M. M. Bhavnagaree, K.C.I.E., distributed medals to various exhibitors at the last Exhibition

held at Bhavnagar under the auspices of the Agricultural and Industrial Association, and highly eulogised the association for its services to the cause of industrial regeneration.

KATHIAWAR

109. An association has been formed in Kathiawar the object of which is to provide modern appliances, implements and tools to the agriculturists and to render them every other help for improvements in agriculture.

APPENDIX A.

INDIAN PATENTS.

APPLICATIONS FILED.

Bhagwan Das, of Ballia, U. P., for a stove for cooking in Indian fashion.

Krishna Chandra Dass, of Calcutta, for electrical resistance film for the purpose of regulator, stove, heating table, resistance board, &c.

Munshi Khairdin, of Nur Mahall, Punjab, for a pump for lifting water.

Mir Nazir Ahmad, of Chak, Sargedha, for a ploughing machine.

Upendra Nath Das, of Calcutta, for an automatic hinge which can be used as a spring bead joint hinge and a spring butt hinge by the different position of spring.

Dulal Chandra Barooah, of Lakhimpur, for stone concrete well rings.

Gozendra Nath Barooah, of Lakhimpur, for an improved method or methods of controlling automatically stabilising plane, ailrons or the like in aeroplane and the like.

Kharak Singh, of Lyallpur, for a water lift.

Furdoonjee Dorabjee Pudumjee, of Poona, for an improved method and apparatus for recording sound applicable particularly to gramophone records.

Fuzul Ahmed, of Gujrat, Punjab, for improvement in water lift double acting piston pump.

Rao Sahib Pandit Matadin Sukul, of Rajashahi, for improved system of boring operations for testing for water supply.

Keshao K Apte, of Serampore, for chula.

Karam Singh and Son, of Maymyo, Burma, for galvanised night soil bucket,

Mohi Nath Paral, Howrah, for moulds for moulding cooking pans of sizes from cast iron or other metals.

Alishaik Bidree, of Sholapur, for improvements in wharving machine and leasing mechanism.

Kharak Singh, of Lyallpur, Punjab, for flour grinding machine.

Rameshur Nath Sahai, of Moradabad, for improved fly shuttle loom.

J. L. Motha, of Tuticorin, for an improved fibre decorating machine.

P. Kehr, of Calcutta, for improvements in aerating machines for soda water bottles and the like.

Hormasji M. Jaorawala, of Jaora, for special adjustment of electrical safe guard cabins avoiding railway collisions within stations.

S. S. B. Naiker, Chulai, Madras, for lifting water from wells and tanks and reservoirs, known as the automatic reversing water lift.

S. G. Nash, of Sabaya, Ranchi, for improvements in gland packing.

Brajendra Kumar Mandal, of Calcutta, for simple, cheap and easy modes of loading, unloading and other works of such nature by the aid of certain machineries, etc.

Ram Rattan Khullar, of Srinagar, for improvement on the well-known Indian exercise called "Dand".

Nehalchand D. Adwani, and Piaralal B. Panjabi, both of Hyderabad, Sind, for wagon theft preventor.

Gaya Prasad Bajpayee, of Cawnpore, for a new process of cooking cakes (rotees) etc., in an improved "angitthi or chula".

Dinshawji Hirjibhoy Todiwalla, of Bombay, for improvements in Mills for grinding sugar.

Sardar Lahna Singh Sahib, of Rawalpindi, for the Rajput perpetual energy motor pump.

Hukam Chand, of Lahore, for unlimited suction height lift and force pump.

Ahmad Shab, of Delhi, for protecting the bottom of tubs

(batlis) by means of a brass band with a groove near the lower edge.

Shiam Lall, of Agra, for snake catcher and killer.

Madan Gopal, of Allahabad, for casting of household vessels in loose earth or sand, of brass, copper and other alloys aluminium, &c.

Pestonjee Cursetjee Mehta, of Bombay, for an improved fuel briquette.

Eduljee Dassobhoy Tambholi, of Bombay, for a device for regulating the speed of spinning frames in starting up.

Sayed Ahmed & Brothers, of Poona, for cooking utensils.

N. B. Bhattacharjee, of Dacca, for fly wheeled quick tiller.

K. C. Das, of Calcutta, for automatic electric fan stopper.

Mian Maula Bux, and C. Allsop, both of Rawalpindi, for improvement in flour, sugar or grain crushing stone mills.

Munshi Betab, of Benares, for a silk and gold thread muslin.

Charn Chandra Ghosh, of Pusa, for doubling and twisting silk and other similar thread called the "Pusa combined doubling and twisting machine."

Allibhoy Vallijee and Sons, of Multan, for an improved Ice box.

Hormusjee Khurshedji Bana, of Bombay, for an improved hydraulic pump.

Harsha Nath Mukerjee, of Dacca for a hydraulic candle stand.

Ram Sarup Mistri, of Allahabad, for a pump for lifting water out of a well of any depth.

SPECIFICATIONS:

28th October 1910—Gulbaz Khan, Lalbaz Khan, of Hyderabad, Sind, for disposal of night soil and rubbish called the "Gulbaz Latrine Incinerator".

16th November 1910—Theettalam Vellaiyachariar, Pachaiyappachariar, of Madras, for goldsmith's metal bar shaper.

Hormusji K. Bana, of Bombay, for an improved hydraulic pump.

Hafeez Abdur Razack, of Cawnpore, for double puttee or tubular legging.

K. A. Raghava Achary and K. A. Manicka Achary, of Madras, for a machine to draw out rough flattened copper (or any other metal) rods into various specific shapes of smooth and well defined curved and angular plates or flat pieces or frames required for various goldsmiths, &c., uses such as being covered with gold plates and made into bangles.

Dosabhoy M. Wadia, of Bombay, for improvements in cotton ring spinning frames.

Abdulla Sharafudin, of Bombay, for improvements in working hot air motor fans.

Hari Bhao Lupne, Karad, Satara, for a machine for shelling and cleaning ground-nuts.

N. D. Hari Ram and Brother, of Rawalpindi, for the simplex patent latrine seat.

Thakorlal N. Yajnik, of Baroda, for "pranava man-jusha" or the division of the Vedic syllable into eight parts by different arrangement of which characters of several languages are formed.

J. L. Motha, of Tuticorin, for an improved fibre decorating machine.

Furdoonjee D. Pudumjee, of Poona, for an improved method and apparatus for recording sound applicable particularly to gramophone records.

Surendra Nath Das, of Howrah, for a pulley power bailing press with an improved follower.

Dwarkanath Harischand Dighe, of Bombay, for improvements in incandescent kerosine lamps.

K. C. Dass, of Calcutta, for making a bicycle stable when not in motion to be called "The cycle stay".

Alla Bux and Abdul Rahim, of Meerut, for oiling cane juice squeezing mills.

Chunnoo Lall Jahory, of Calcutta, for an improved of securing jewels in settings of ornaments.

S. G. Nash, of Ranchi, for improvement in gland packing.

Tehentan Baman Shaw of Bombay, for an improved key for regulating sluices, hydrants and underground stopcocks affixed to water pipes.

Mobkun Singh & Sons, of Gujranwala, for harmonium.

Perojshaw Burjorjee Godrej, of Bombay, for improvements in fire proof safes.

The Arya Factory, Calcutta, for padlock.

Kharak Singh, of Lyallpur, Punjab, for lifting water from wells, &c.

DESIGNS REGISTERED.

Abdolabhoy Joomabhoy Lallijee and Co., merchants of Calcutta, for a drill and spot pattern for textile.

Jatindra Nath Mookerjee, of Hooghly, Bengal, for an umbrella- holder for bicycles.

Sham Narayan Srivastavya of Agra, for sheet iron chula with fireplace, chimney and openings for cooking.

Sumer Chand Sham Lall Sadh, of Farrukhabad, for a design for printed textile goods for sprays of leaves and flowers with birds in the centre and border.

Baola Nath Jotish Ram, Dumraon, Shaliabad, for a silver armlet, known as Katni Bazoo.

APPENDIX B

JOINT STOCK COMPANIES

Number and particulars of Joint Stock Companies registered in each Province in British India in twelve months with October 1911.

No.	Class and Name.	Situation of Registered Office.	Object.	Nominal Capital.
I. BANKING, LOAN AND INSURANCE.				Rs.
(a) BANKING AND LOAN.				
1	Gaibandha Loan office	... Gaibandha E. B. and Assam	Money lending	50,000
2	Swami Kariya Manika Perumal Sahaya	... Dravia		
8	Uddiyog Sahaik Company	... Kadayanallur, Madras	Money lending	80,000
4	Karachi Bank	... Bijnor, United Provinces	Banking business	1,00,000
5	Sind Bank	... Karachi, Bombay	Banking business	5,00,000
6	Trichinopoly City Bank	... Hyderabad (Sind), Bombay	Banking, etc.	25,00,000
7	Bridgemanganj Bank	... Trichinopoly, Madras	Banking, etc.	49,995
8	Ballia People's Agricultural and Trading Bank	... Gorakhpur, U. Provinces	Banking, etc.	1,00,000
9	Jullundur Bank	... Ballia, U. Provinces	Banking, etc.	20,000
10	Chennai Sri Rama Janopakara Nidhi	... Jullundur, Punjab	Banking and Comission Agency	5,00,000
11	Madaripur Bank	... Madras	Money lending (mutual)	4,20,000
12	Kanayakubja Mercantile Bank of India	... Madaripur, E. B. and Assam	Banking and money lending	20,000
13	Shrikrishna Agency Company	... Cawnpore, U. Provinces	Banking Do.	10,00,000
		... Ahmedabad, Bombay	Banking Do.	50,000

14	Athur Saswatha Dravia Sekara Nidhi	... Athur, Madras	... Moneylending (mutual)	... 49,995
15	Nallattur Union Bank	... Nallattur, Madras	... Do.	... 20,000
16	Model Assurance and Banking Company	... Chittagong, E. B. and Assam	... Banking, money lending etc.	... 3,00,000
17	Bank of Behar	... Bengal	... Banking	... 10,00,000
18	British India Bank	... Allahabad, U. Provinces	... Do.	... 2,50,000
19	Hindu Bank	... Tanjore, Madras	... Do.	... 39,995
20	Madukarai Jananukula Nidhi	... Coimbatore, Madras	... Money lending (mutual)	... 1,00,000
21	Vellore Panapatti Sri Mada Vara Nidhi	... Vellore, Madras	... Do	... 1,00,000
22	Hazaribagh Bank	... Bengal	... Banking, etc.,	... 20,000
23	United Indian Bank	... Allahabad, U. Provinces	... Do.	... 5,00,000
24	Kalavai Sri Kari Varada Raja Perumal Saswatha Dravia-Sahaya Nidhi	... Kalavai, Madras	... Money lending (mutual)	... 39,950
25	Gopalganj Banking and Trading Company	... Gopalganj, E. B. & Assam	... Carrying on banking and trading business	... 20,000
26	Bundelkhand Bank	... Ternanganj, U. Provinces	... Banking, etc.	... 20,000
27	Triplicane Madariya Saswatha Elanidhi	... Madras	... Money lending (mutual)	... 36,750
28	Alipur Duar Banking Corporation	... Jaipauri, E. B. & Assam	... Banking and money lending	... 50,000
29	Jotedar Banking and Trading Corporation	... Do	... Do.	... 10,000
30	Korimganj Loan Banking and Agency	... Sylhet, E. B. & Assam	... Banking, money lending & agency	... 1,00,000
31	Mutual Banking and Assurance	... Lahore, Punjab	... Life Insurance and banking	... 2,50,000
32	Ootacamund Srikistna Vilasa Nidhi	... Ootacamund, Madras	... Banking	... 1,00,000
33	Bhatdi Loan Office Company	... Faridpur, E. B. & Assam	... Money lending	... 20,000
34	Baharpur Bank	... Do.	... Banking and trading	... 20,000
35	Bengal Duars Bank	... Jalpaiguri E. B. & Assam	... Banking and money lending	... 2,00,000
36	Bank of Rajputana and Punjab	... Ambala, Punjab	... Banking	... 2,00,000
37	Coronation Banking and Assurance Company	... Lahore, Punjab	... Banking and Insurance	... 1,00,000
38	Indian Finance Corporation	... Bombay	... Banking	... 5,00,000
39	Kalikachha Loan Company	... Tippera, E. B and Assam	... Banking and Insurance	... 10,000
40	India Exchange Bank	... Simla, Punjab	... Banking	... 5,00,000
41	Pioneer Bank	... Bombay	... Banking	... 50,00,000

No.	Class and Name.	Situation of Registered Office.	Object.	Nominal Capital.
	(b) INSURANCE.			Rs.
42	Irawati General busfness Company	... Lahore, Punjab	... Insurance banking and General Trading	1,00,000
43	Popular Marriage Fund	... Multan, Punjab	... To collect funds to pay Mem- bers on occasions of marriage...	50,000
44	Mahalaxmi Provident and Banking Co.	... Chittagong, E.B. & Assam...	... Insurance banking and money lending, etc.	5,00,000
45	Co-operative Provident Fund	... Calcutta, Bengal	... Carrying on business of provi- dent Company	20,000
46	Capital Assurance Company	... Calcutta, Bengal	... Life Insurance	10,00,000
47	Popular Assurance Provident Fund	... Rawal Pindi, Punjab	... Life Insurance, etc.	1,00,000
48	Amritsar Mutual Relief Fund	... Amritsar, Punjab	... Life and Marriage insurance and banking	1,00,000
49	Chattal Laksmi Life and Marriage In- surance Company	... Chittagong, E. B. & Assam...	... Insurance	1,00,000
50	Bharat Sramajibi Mutual Benefit Fund	... Chittagong, E.B & Assam...	... Insurance	20,000
51	Barba Bhanga Nababidhan Insurance Company	... Chittagong, E.B. & Assam...	... Insurance	20,000
52	Bengal Assurance Company	... Howrah, Bengal	... Life Insurance	25,000
53	India Provident Company	... Bengal	... Provident Fund	20,000
54	Hindu Biwah Sahaik Fund	... Multan, Punjab	... Collecting funds for marriages...	20,000
55	Peoples Mutual Education Relief Society...	... Dera Ismailkhan, Punjab	... Making provisions for education...	20,000
56	Bharat Bandhab Assurance Company	... Silchar, E. B. & Assam	... Insurance	30,000
57	Punjab Assurance and Mutual Benefit Society	... Hazra, Punjab	... To collect funds for payments to Members at marriages and deaths,	1,00,000
58	Coronation General Business Company	... Peshawar, North West Frontier Province	... To insure lives and buildings etc...	1,00,000
59	British Empire Aid Association	... ..	... Assurance life	20,000

60	Burma Mutual Benefit Society	...	Rangoon, Burma	...	General Insurance	18,000
61	Loyalty Assurance Company	...	Chittagong, E.B. & Assam	...	Do.	50,000
62	Bharat Provident and Banking Company	...	Bengal	...	Insurance	50,000
63	Star of India Insurance Company	...	Do.	...	Do.	1,00,000
64	Upper India Insurance and Banking Company	...	Benares, U. Provinces	...	General Insurance and Banking	1,00,000
65	Indian National Benefit Society	...	Lahore, Punjab	...	Insurance	20,000
66	National Sahaita Fund	...	Peshawar, N. W. F. Province	...	Do.	1,00,000
67	Kamala Provident Fund	...	Calcutta, Bengal	...	Life Assurance	50,000
68	Madurra Mutual Benefit Society	...	Chittagong, E. B. and Assam	...	Carrying on Insurance Business	10,000
69	Eastern Bengal Radhakrista Benefit Society,	...	Do.	...	Do.	20,000
70	Indian Death Benefit and Marriage Endowment Society	...	Do.	...	Do.	20,000
71	Banga Lakshmi Paraspara Sahujya Bhandar Company	...	Do.	...	Do.	10,000
72	Universal Assurance Company	...	Bengal	...	Do.	1,00,000
73	Victoria Life Insurance Company	...	Bengal	...	Do.	20,000
74	General Hindu Provident Fund	...	Lahore, Punjab	...	Making provision for families & dependents	20,000
75	Punjab Marriage and Life Assurance Company	...	Muzaffargarh, Punjab	...	Carrying on insurance business	1,00,000
76	Douba Assurance and Mutual Relief Fund	...	Jullunder, Punjab	...	Do.	10,000
77	Co-operative Credit and Relief Society	...	Lahore, Punjab	...	Do.	50,000
78	Hitashadhini Mutual Benefit Fund	...	Chittagong, E. B. & Assam	...	Fire, life and marriage insurance	10,000
79	Fotehabad Samaboy Beema Mandali	...	Do.	...	Fire, life, marriage and marine insurance	20,000
80	Chittagong Provident Fund Company	...	Do.	...	Do.	5,000
81	Bharat Shabajya Bhandar	...	Do.	...	Do.	20,000
82	Gajbarria Paraspara Sahajya Bhandar Company	...	Do.	...	Life, marriage and insurance etc.	10,000
83	Mitra Biswas Insurance and Banking Corporation	...	Bengal	...	Insurance and Banking	10,00,000

No.	Class and Name.	Situation of Registered office.	Object.	Nominal Capital.
				Rs.
84	Marriage and Death Benefit Association ...	Wazirabad, Punjab ...	Marriage insurance	1,00,000
85	Victoria Provident Fund ...	Chittagong, E. B. & Assam ...	General insurance	20,000
86	Jagannath Mutual Benefit Fund ...	Dabna, E. B. & Assam ...	Life and marriage insurance	20,000
87	British Empire Assurance Company ...	Feringibazar, E. B. & Assam ...	General insurance	20,000
88	Moslem Sahaya Somitee ...	Sitakund, E. B. & Assam ...	Life insurance	20,000
89	New India Insurance and Banking Com- pany ...	Bengal ...	Do.	1,00,000
90	Public Educational Supporting Company ...	Amritsar, Punjab ...	Life, marriage and education assu- rance	1,00,000
91	Punjab Relief Fund ...	Gujarkhan, Punjab ...	Do.	1,00,000
92	Lahore General Business Company ...	Lahore, Punjab ...	Life, Marriage and Education Assurance	20,000
93	Paropkari General Business Company ...	Pail, Punjab ...	Do	50,000
94	Hindu Musalman Mutual Relief Fund ...	Muzffargarh, Punjab ...	Do	1,00,000
95	Indian Marriage and Relief Fund ...	Lahore, Punjab ...	Do	20,000
96	Rawalpindi Co-operative Marriage and Insurance Fund ...	Rawalpindi, Punjab ...	Do	1,00,000
97	Hindustan Business Company ...	Lahore, Punjab ...	Do	20,000
98	Frontier Shadi Fund ...	Peshawar, N. W. F. Pro- vince ...	To Distribute Contributions at Marriages	1,00,000
99	People's Relief Fund ...	Bannu, Do ...	To Distribute Contributions at Marriages and deaths	50,000
100	Bharat and Baluchistan Aid Association ...	Shikarpur, (Sind) Bom- bay ...	Life and Fire Assurance	20,000
101	Co-operative Trading and Insurance Company. ...	Silchar, E. B. and Assam ...	Carrying on Insurance and Banking, etc.,	20,000
102	Sarbamangala Gourisunkar Insurance Company ...	Chittagong, E. B. and Assam ...	Carrying on Life and Marriage... Insurance	20,000

103	Eastern Bengal Assurance and Provident Fund	Do	Do	25,000
104	National Assurance and Benefit Society	Bengal	Life Insurance	1,00,000
105	East Co-operative Insurance Company	Calcutta, Bengal	Do	20,000
106	Crown Provident Fund	Bengal	Do	10,000
107	Star of India Insurance Company	Do	Do	10,00,000
108	Industrial Agency and Insurance Co.	Salkia, Bengal	Life and General Agency	20,000
109	All India Provident Fund	U. P. of Agra and Oudh	General Insurance	20,000
110	Public Sahni Business Company	Pail, Punjab	Making Provisions for Marriages, etc.,	50,000
111	Gujranwala Mutual Relief Fund	Gujranwala, Punjab	Do	1,00,000
112	Sick Family Relief Fund	Do	Do	20,000
113	National Relief Corporation of India	Sikarpur, (Sind) Bombay	General Insurance	20,000

II TRADING.

(a) NAVIGATION, RAILWAYS AND

TRAMWAYS CO-OPERATIVE ASSOCIATIONS.

114	Bangiya Inland Steam Navigation and Trading Company	Calcutta, Bengal	Carries by land and water	1,00,000
116	Central Provinces Railway Company	Bombay	Working railway	60,00,000
116	Chakurdharpur Railway Co-operative Stores	Chakurdharpur, Bengal	Selling wines, etc	10,000
117	Arab Steamers	Bombay	Navigation	10,00,000
118	Jessore Jhenidah Railway Company	Calcutta, Bengal	Constructing a railway line between Jessore and Jhenidah, etc.	12,50,000
119	Guzerat Railway Company	Bombay	Constructing railways	50,00,000
120	Assam-Bengal Railway Co-operative Society	Chittagong, E. B. & Assam	Supplying goods to the A. B. Railway employees	80,000
121	Co-operation Sport Works	Sialkot, Punjab	Manufacturing, importing and exporting sporting goods	2,00,000

No.	Class and Name.	Situation of Registered office.	Object.	Nominal capital.
122	Ahmedabad in Arasparas Sahekari Ane Nava Dhirnari and General Store Supplying Company	... Ahmedabad, Bombay	... Supplying Stores on co-operative principle	Rs. 10,000
123	Chinese Steam Ship Company	... Rangoon, Burma	... To acquire and work the S. Engine of Steamers	23,10,000
124	North Indian Feeder Railways	... Abotabad, N. W. F. Province	... Constructing railways	50,00,000
125	Co-operative Land Improvement Society	... Calcutta, Bengal	... Improving agricultural, horticultural and allied industries on modern Scientific methods	1,00,000
126	Devi Annapurna Co-operative Society	... Bombay	... Starting co-operative Stores	20,000
127	Co-operative Business Company of India.	... Dera Ismail Khan, N. W. F. Province	... Carrying on general trade and insurance	10,000
128	Popular General Business Company	... Do.	... Do.	10,000
129	Empire Business Company	... Do.	... Do.	10,000
	(b) OTHERS PRINTING, PUBLISHING, STATIONERY, ETC.			
180	Saramajibi Samavaya	... Calcutta, Bengal	... General Traders	1,00,000
181	Punjab Traders Company	... Lahore, Punjab	... Importers, Exporters and Commission Agents	25,000
182	Vaisya Vyaparotejah Co.	... Belagiri, Bombay	... Merchants and Commission Agents	1,00,000
183	Hind-Lights	... Bombay	... Manufacturers of lamps, burners etc.	50,000
184	Indo Arabian Trading Co.	... Bombay	... Brokers and Agents	2,00,000

135	Clarke Industrial Works	... Poona, Bombay	... Manufacturing Stationery	1,00,000
136	Industrial Development Company	... Sylhet, E. B. & Assam	... Starting factories for manufactur- ing ivory tin	20,000
137	Calcutta Tanning Syndicate	... Calcutta, Bengal	... Tanners, curers, dealers in hides and leather articles	50,000
138	Berhampore Leather Manufacturing Company	... Bengal	... Manufacturers, and dealers of leather goods, hides	1,00,000
139	Ganesh Beopar Company	... Beawar, Ajmer-Merwara	... Trading	2,00,000
140	Tata Hydro-Electric Power supply Company	... Bombay	... Supplying Electricity	2,00,00,000
141	Bombay Fishery Company	... Bombay	... Fishing etc.	2,00,000
142	Aspinwall and Company	... British Cochin, Madras	... General Merchants	15,00,000
143	Badarpur Trading Company	... Sylhet, E. B. & Assam	... Dealing in Miscellaneous goods	20,000
144	S. Dass and Company	... Calcutta, Bengal	... Manufacturing and dealing in Motor Cars, etc.	50,000
145	Edward Soap Manufacturing Company	... Pind Dadan Khan, (Jhelum) Punjab	... Manufacturing Soap	1,00,000
146	Agricultural and Commercial Works	... Amritsar, Punjab	... Starting workshop and develop- ing industries	1,00,000
147	Oldham Boiler Fluid Company	... Bombay	... Supplying the Oldham Boiler Fluid, Trading and Commission Agency	30,000
148	Mulgnm Ginning and Trading Company	... Mulgum, Bombay	... Trading and Commission Agency	25,000
149	Wyndham Lloyd & Company	... Bombay	... Trading and Commission Agency	50,000
150	Alliance Advertising Association	... Cawnpore, U. Provinces	... Printers, Publishers, Lithographers, etc.	1,00,000
151	Malda Swadeshi Bhandar	... Malda, E. B. & Assam	... Dealing in Miscellaneous goods made in India.	20,000
152	Chittagong Motor Service & Trading Company	... Chittagong, E. B. & Assam	... Running Motor cars for carrying passengers and goods.	1,00,000
153	C. Lazarus and Company	... Calcutta, Bengal	... Decorators and Cabinet makers	7,00,000
154	Chatterjee Furnishing Company	... Calcutta, Bengal	... Do.	44,000

No.	Class and Name.	Situation of Registered office.	Object.	Nominal Capital.
				Rs.
155	Kshatriya Swakar Company	... Azamgarh, U. Provinces	... Dealing in Gold and Silver	50,000
156	Ford and MacDonald	... Cawnpore, U. Provinces	... Manufacturing bricks, tiles, etc.	64,000
157	Punjab Lime Manufacturers Association	... Rawalpindi, Punjab	... Manufacture of lime, cement etc	50,000
158	Union Hosiery and Manufacturing Company	... Bombay	Manufacturers, bleachers	2, 50,000
159	R. G. Baldock	... Bombay	General traders	6,00,000
160	Salkia Printing Works	... Bengal	Printers, Publishers, and Stationers	1,00,000
161	Burma Charcoal Trading and Supply Company	... Rangoon, Burma	Manufacturing and selling charcoal	20,000
162	Bhaungach Trading Company	... Shamsernagar F. B. and Assam	General Trade	15,000
163	T. B. Norton and Sons	... Calcutta, Bengal	Engineers, Plumbers, Contractors etc.	5,00,000
164	Hindustan Art Trading Company	... Bengal	Manufacturing and dealing in embroidery, etc.	25,000
165	Petroleum Products Company	... Calcutta, Bengal	Trading and Agency	1,50,000
166	Punjab Glass Works	... Lahore, Punjab	Manufacturing Glass Etc.	2,00,000
167	Cherry Press	... Bengal	Printing Publishing Etc.	2,00,000
168	Min Tien Kung Pao Company	... Rangoon, Burma	Printing and Publishing Chinese newspapers, Etc.	20,000
169	Burma Model Laundry	... Rangoon, Burma	Washing and dyeing clothes	30,000
170	Indian Dairy and Poultry Farm	... Calcutta, Bengal	Carrying on dairy business Etc.	30,000
171	Tirtta Bazar	... Do.	General Trade	3,20,000
172	Scientific Instrument Company	... Allahabad, U. Provinces	Manufacturing and dealing in Scientific Apparatus, Etc	30,000
173	Saraswati Trading Corporation	... Jaunpur, U. Provinces	General Trade	50,000
174	Raghunath Govind Dixit and Company	... Poona, Bombay	Traders	20,000
175	Glass and Commission Agency	... Do.	Commission Agents	2,00,000

176	South Indian Tobacco Company	... Madras	Manufacturing Tobacco	5,00,000
177	Muslim Commercial Union	... Do.	Import and Export Agents	1,00,000
178	Burma Sanitary Steam Laundry	... Rangoon, Burma	Starting laundries	30,000
179	Buddhist Corporation	... Do.	General trade and Agency	1,00,000
180	Dacca Electric Supply Company	... Calcutta, Bengal	Mechanical Engineers, Electricians, etc.	5,00,000
181	Nagpur Electric Light and Power Company	Nagpur, C. P. and Berar	Electricians and suppliers of electric light and power	5,50,000
182	Clubwalla and Company	... Bombay	Trading in Machines, etc.	1,00,000
183	Mercantile Trading Agency	... Ahmedabad, Bombay	General Trade	50,000
184	Dharapuram Hindu Trading Company	... Dharapuram, Madras	General Trade Manufacturing Soaps etc.	15,000
185	Aryan Trading and Insurance Company	... Silchar, E. B. and Assam	Printing and Publishing etc.	10,00,000
186	City of Calcutta Dairy Company	... Calcutta, Bengal	Dairy business	50,000
187	Kandi Conveyance Company	... Murshidabad, Bengal	Supplying conveyances on hire	10,000
188	Delhi Metal Works	... Delhi, Punjab	Manufacturing metal & metal goods	1,00,000
189	Pothohar Soap Company	... Gujarkhan, Bengal	Manufacturing soaps, candles, etc.	1,00,000
190	Commercial Trading Company	... Bombay	General Trading	50,000
191	Bharat Mutual Aid Association	... Sukkur, Bombay	General Trading	50,000
192	Shamsi and Company	... Moradpore, Bengal	Drapers, tailors and out fitters	50,000
193	Bengal Company	... Calcutta	General Traders and Agents	50,000
194	Sher-i-Punjab Soap Company	... Gujranwalla, Punjab	Manufacturing soap, etc.	2,00,000
195	Bomay Cattle Breeding and Milk Supply Company	... Bombay	Breeding cattle & supplying milk	2,50,000
196	Mercantile Association Company	... Ahmedabad, Bombay	Commission Agents	1,00,000
197	Sahitya Prachar Samiti	... Calcutta, Bengal	Printers and Publishers, etc.	20,000
198	Pabna Srantu Silpi Hosiery and Banking Company	... Pabna, E. B. and Assam	Manufacturing hosiery, etc.	1,00,000
199	Pottery and Stone Ware Company	... Bengal	Manufacturing tiles, bricks, etc.	1,00,000
200	Cu-operative Union of India	... Calcutta, Bengal	General Traders	1,00,000
201	Bengal Candle Company	... Calcutta, Bengal	Manufacturing candle, soaps, cigar, etc.	20,000

No.	Class and Name.	Situation of Registered Office.	Object.	Nominal Capital.
				Rs.
202	Eagle Foundry Company	Bengal	Manufacture and sale of castings	1,00,000
203	Metropolitan Engineering Company	Calcutta, Bengal	Engineers and contractors	2,00,000
204	Reliance Medical Store	Do.	Trading in medicines, etc.	1,00,000
205	Hide and skin House	Cawnpore, U. Provinces	Dealing in hides and skins etc.	1,00,000
206	Karachi Supply	Karachi, Bombay	General Traders	1,00,000
207	Foreign India Agency	Bombay	Do	2,00,000
208	Godavari Pencil Company	Cocanada, Madras	Manufacturing Pencils etc.	25,000
III. MILLS AND PRESSES.				
(a) COTTON AND JUTE SCREWS AND PRESSES FLOUR, MILLS.				
209	Bansihal Gungaram, Cotton ginning Pressing and Industrial Manufacturing Company.	Nandgaon, Bombay	... Ginning and pressing Cotton ...	1,00,000
210	Kalyan Revival Mills	... Kalyan, Bombay	... Spinning and Manufacturing Cotton, etc. ...	1,00,000
211	Tribhowandas Ginning Company	Viramgaum, Bombay	... Ginning Cotton and Selling Fibres.	71,000
212	Prabhukar Ginning Factory	... Beawar, Merwara	... Ginning Cotton etc	64,000
213	Empire Flour Mills Company	... Calcutta, Bengal	... Manufacturing Flour, etc.	4,00,000
214	Hooghly Flour Mills Company	... Calcutta, Bengal	... Manufacturing Flour, etc.	7,00,000
215	Himalaya Ginning and Trading Company.	Ambala, Punjab	... Ginning and bailing Cotton, etc....	50,000
216	Calcutta City Flour Mills Company	... Bengal	... Manufacturing Flour, rice, etc.	4,00,000
217	Islam Silk Manufacturing Company	... Bombay	... Spinning, Weaving manufacturing Silk, fibres etc.	75,000
218	Sri Chittambara Vinayakar Mills	... Madras	... Spinning and Weaving Cotton	7,00,000
219	Ganges Cotton and Flour Mills Company	... Kankhal, U. P. of Agra and Oudh	... Ginning and manufacturing wool, etc.	50,000

220	Kuhair ^r Cotton Ginning and Press Factory Company	Debai, U. P. of Agra and Oudh	Ginning and manufacturing wool etc.	1,25,000
221	Bijapur Merchants' Pressing and Ginning Company	Bijapur, Bombay	Ginning and pressing Cotton etc...	95,000
222	Zamindar Ginning Company	Bhalwal, Punjab	Ginning, cleaning pressing manufacturing Cotton, etc.	3,00,000
223	Sri Ramar Ginning Factory	Athipalayam, Madras	Ginning Cotton etc.	20,000
(b) RICE MILLS.				
224	Baniyachang Rice Mills Company.	Baniyachiang, E. B. and Assam	Manufacturing rice, planting, Trading etc.	1,00,000
225	Dadar Rice Oil Mills Company.	Calicut, Madras	Milling rice, etc	1,00,000
226	Lakshmi Nrusimha Gin and Rice Factory	Guntur, Madras	Milling rice and Ginning cotton, etc.	65,000
IV. TEA AND OTHER PLANTING COMPANIES.				
(a) TEA.				
227	Ballacherra Tea Company	Calcutta, Bengal	Cultivators and manufacturers of Tea etc.	2,00,000
228	All India Tea and Trading Company	Sylhet, E. B. and Assam	Cultivation and manufacture of Tea etc.	10,00,000
229	Neptune Estates	Calcutta, Bengal	Cultivating and manufacturing Tea etc.	50,000
230	Gillapukri Tea and Seed Company	Calcutta, Bengal	Cultivators and manufacturers of Tea etc.	1,80,000
231	Diana Tea Company	Jalpaigiri, E. B. and Assam.	Cultivating and manufacturing Tea and Coffee	1,25,000
232	Dheklapara Tea Company	Jalpaigiri, E. B. and Assam.	Planting Tea and Coffee	1,25,000
233	Bogabagh Tea Company	Calcutta, Bengal	Do	1,60,000

No.	Class and Name.	Situation of Registered office.	Object.	Nominal Capital.
(b) OTHERS.				Rs.
284	Mergui Brown Rubber Estates	... Rangoon, Burma	... Cultivating Para rubber etc.	22,50,000.
235	Chulsa (Selangor) Rubber Company	... Calcutta, Bengal	... Planting and Manufacturing rubber, Tea, copper, etc	7,50,000.
236	Karnal Rubber Company	... Karnal, Punjab	... Planting rubber and dealing in Guttaparcha & other substances.	2,00,000.
237	Eddivanna Rubber and Tea Company	... Calicut, Madras	... Planting Tea and Rubber etc.	3,75,000.
238	Pathee choung Rubber Company	... Rangoon, Burma	... Cultivation of Rubber	3,30,000
V. MINING AND QUARRYING ASSOCIATIONS.				
(a) COAL.				
239	Burma Coal Company	... Rangoon, Burma	... Carrying on business of colliery proprietors, coke manufacturers, miners etc.,	2,50,000.
240	Khiroda Coal Company	... Bengal	... Coal mining	50,000
241	Satvis Coal Company	... Calcutta, Bengal	... Carrying on coal business	2,00,000.
(b) GOLD.				
242	Egari (Tavoy) Mining Company	... Rangoon, Burma	... Exploring, prospecting for gold minerals and precious stones	50,000.
243	Burma Gold Dredging Company	... Rangoon, Burma	... Carrying on business of gold dredging & other metallurgical operations, etc.	10,50,000.

(c) OTHERS.

244	Bisra Stone Lime Company	... Calcutta, Bengal	... Manufacturing lime and dealing in stone, cement, etc., ...	4,00,000
245	Irawaddy Petroleum Oil Syndicate	... Rangoon, Burma	... Working, developing and exploiting oil bearing lands ...	3,00,000
246	Minbu Mansat Company	... Minbu, Burma	... Exploring mining for earth oil, minerals, etc. ...	3,00,000
247	Burma Boring Company	... Rangoon, Burma	... Boring for oil and prospecting for other minerals, etc. ...	2,00,000
248	Punjabue Petroleum Syndicate	... Do.	... Mining for mineral oil and other products ...	8,00,000
249	Moolla Oil Company	... Do.	... Mining for mineral oil and refining oil, etc. ...	45,00,000
250	Hermyin Gyi Mining Company	... Rangoon, Burma	... Mining and dealing in minerals and ores, etc. ...	6,00,000
251	Shamuddin Oil Company	... Do.	... Prospecting, refining and dealing in Petroleum, etc. ...	15,00,000
252	Bilaspur Lime and Stone Company	... Calcutta, Bengal	... Manufacturing lime, coke, etc. & dealing in stone ...	1,00,000
253	Saray Stone Lime Company	... Do.	... Do ...	1,50,000
254	Bawnin Mines Syndicate	... Rangoon, Burma	... Mining, Smelting, etc. ...	1,00,000
255	Upper Burma Mineral Prospecting Syndicate	... Saguig, Burma	... Prospecting, developing property for minerals ...	50,000
256	India and Burma Khedah Company	... Chittagong, Burma	... Carrying on Khedah operations ...	30,000
257	Vadheswaram and Kolanukonda lift Irrigation Company	... Vadheswaram, Madras	... Constructing irrigation channels for watering fields from the Kiatna canal ...	22,950
258	Magwe Oil Company	... Rangoon, Burma	... Mining, refining and dealing in Petroleum oil ...	15,00,000

No.	Class and Name.	Situation of Registered office.	Object.	Nominal Capital.
259	Star Theatre	... Calcutta, Bengal	... Theatrical performances	Rs. 2,00,000
VI. SUGAR AND ICE MANUFACTURING COMPANIES, BREWERIES AND OTHERS.				
260	Batsi Sugar Works.	... Batsi, U. Provinces.	... Manufacturing Sugar molasses Sugar etc.	... 5,00,000
261	Madras B. B. B. Brewery Company	... Madras.	... Brewers and distillers etc.	... 2,50,000
262	Amritsar Sugar Works	... Amritsar, Punjab	... Manufacturing Sugar	... 2,00,000
263	Siddly Ice Manufacturing Company	... Bombay	... Manufacturing Ice etc.	... 2,50,000
264	Madras Nursing Home	... Madras	... Establishing Nursing Home	... 1,00,000

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