

# THE INDUSTRIAL CONFERENCE

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# THE INDUSTRIAL CONFERENCE.

## H. H. THE GAEKWAR'S INAUGURAL ADDRESS.

MR. PRESIDENT, DELEGATES TO THE CONFERENCE, LADIES AND GENTLEMEN,—It was only last month, on my return from a tour in Europe and America, that your able and energetic Secretary, Rao Bahadur R. N. Mudholkar, called on me, and conveyed to me the Industrial Committee's unanimous request that I should attend this Conference and deliver an Inaugural Address. I naturally felt some hesitation in acceding to this request, partly because of the pressure of administrative work owing to my recent return from a foreign tour, and partly because I am aware that there are others who are better qualified than myself to advise you in the noble work which you have undertaken.

But, Gentlemen, your Secretary was not to be put off by these reasons. He pressed me to accede to the request of the Industrial Committee, and was good enough to assure me that by so doing I would be rendering some service to the great cause which we all have at heart. To this argument I felt it my duty to yield. I feel very strongly that to help in the industrial movement of the present day is a duty which devolves on all of us equally.

Whatever be our vocations in life, we cannot be untrue to this duty without being untrue to ourselves and our country. And I feel to-day, as I have always felt and declared, that our interests are one and the same: whatever helps and elevates you, helps and elevates us; whatever retards your progress retards ours. And, furthermore, I am strongly convinced that our activities in all different departments of life, political, social and industrial, are so correlated that we



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shall never make any marked progress in one without making similar progress in all.

The three seemingly diverse currents of intellectual activity converge towards the same head-works and feed the same main stream of life. Unless we extend our horizon and take a less parochial view, we can ill-understand the value and place of each of these component parts in the great machinery of progress.

### PAST HISTORY.

Gentlemen, I do not propose to take much of your time with an account of the industries of India in the ancient times, but a brief reference to some notable facts will perhaps not be unsuitable on an occasion like this. You are all aware that India was famed for her cotton fabrics from very ancient times; and antiquarians tell us that Indian cotton found its way to Assyria and Babylon in the remote past. Indigo, which is peculiarly an Indian produce, has been detected by the microscope in Egyptian mummy cloths, and Indian ivory and other articles were probably imported into ancient Egypt. There can be little doubt that the old Phoenicians carried on a brisk trade with India, and much of the spices and precious stones, ebony, gold and embroidered work, with which they supplied the Western world, came from India.

The Greeks rose in civilization at a later date; and Herodotus, generally called the Father of History, speaks of Indian cotton as "wool growing on trees, more beautiful and valuable than that produced from sheep".

A brisk trade between India and the Western world was carried on during the centuries preceding the Christian era, and as Rome rose in power and importance, and Alexandria became a flourishing mart, the trade increased in volume. Silk threads, sapphires, indigo and cotton fabrics were exported from the mouths of the Indus; and the important sea-port town of Broach, then called Bharukatcha

by the Hindus, and Barygaza by the Romans, imported gold, silver and other metals, glass, corals and perfumes; and exported precious stones, muslins, cotton fabrics, ivory, ebony, pepper and silk.

The Roman Empire declined after the third century. An Eastern Empire was founded with its new capital at Constantinople, and that place attracted to itself much of the Asiatic trade which used to flow before through Alexandria.

India was the scene of frequent invasions during the centuries succeeding the Christian era, and Scythians and Huns desolated her western provinces. But a great chief and warrior, known to our literature under the name of Vikramaditya, at last turned back the tide of invasion, and India was virtually free from foreign raids from the sixth to the tenth century. It was within this period that Chinese travellers, Fa Hian, Houen Tsang, and others visited India as religious pilgrims, admired the arts, industries, and manufactures, and wrote on the Hindu temples and Buddhist monasteries, which existed side by side in every large town. Hindu traders founded settlements in Java and the other islands; and it was in a Hindu ship, sailing from Tamralipti or Tamlook, that Fa Hian left India. Those of you who have been to Europe and visited the continental towns may have seen images of Hindu gods and goddesses in the Museum of Leyden, taken there by the Dutch from Java, where Hindu religion and learning were introduced by traders and settlers from India.

Venice was the channel of trade with India after the close of the dark ages; but the glory of Venice departed with the discovery of a new route to India round the Cape by Vasco de Gama about the close of the fifteenth century, and Portugal rose in power and commercial enterprise as Venice declined. In the sixteenth century, all the southern seaboard of Asia as far as China was practically under the commercial control of Portugal. But the Dutch replaced the

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Portuguese in the seventeenth century, and, like the latter, enriched themselves by the Indian trade. Likewise the English appeared on the scene a little later and wrested from the Dutch a large share of the Eastern trade in the eighteenth century. It is remarkable that, within the last thousand years, nation after nation in Europe has risen to power and to great wealth mainly through the Eastern trade. Constantinople, Venice, Portugal, Holland and England have successively been the carriers to Europe of the rich manufactures of India, as the Phœnicians and the Arabs were in the ancient times.

When England obtained territorial possessions in India in the eighteenth century, her commercial policy towards India was the same as her policy towards Ireland and her American Colonies. Her aim and endeavour was to obtain raw produce from her dependencies and to develop manufacturing industry in England. She repressed manufactures elsewhere by unequal tariffs in order to develop her own manufactures. The American Colonies freed themselves from this industrial servitude when they declared their independence; but both Ireland and India suffered. Industries in both these countries steadily declined early in the nineteenth century; manufacturing industries progressed by leaps and bounds in England, and the invention of the power-loom completed her industrial triumph.

Since then England has slowly adopted a fair and equitable commercial policy and repealed Navigation Acts and unequal tariffs. And to-day England stands forth a pre-eminent free trader to all the world; and this brings me, Gentlemen, to the industrial history of India of our own times.

#### PRESENT SITUATION.

The triumph of machinery has been the triumph of our age: the victory of steam and electricity will always be memorable among the decisive battles of the world. The rise of power-looms, for instance, has been stealing

a march over the hand-loom workers, and the numbers employed in cotton weaving in India have declined by 23 per cent., even within the last decade. Even the ginning and the pressing of cotton has so extensively participated in the use of improved machinery that its hand workers have dwindled by fully 86 per cent. And yet it is this textile industry itself which shows how, with intelligent adaptation to the improved methods of art, our Indian industries can compete with the manufactures of Europe. The Bombay mills give daily employment to about 1,70,000 factory operatives, while so many as 30,000 more are maintained by the ginning presses. Some forty years ago we had only 13 cotton mills in all India. The number rose to 47 in 1876, to 95 in 1886, to 155 in 1895, and to 203 in 1904; and to-day the number of our cotton mills is still larger. We had less than 4,000 power-looms forty years ago: the number was over 47,000 in 1904. We had less than 3,00,000 spindles 40 years ago: the number exceeded five millions in 1904. These are insignificant figures compared with the huge cotton industry of Lancashire; but they show that we have made steady progress, and that we may fairly hope to make greater progress in the future if we are true to our aims and our own interests. Our annual produce of yarn is nearly six hundred million lbs. in weight; and it is interesting to note that out of this total outturn about 30 per cent. is used mostly by our hand-loom weavers.

Gentlemen, it is with a legitimate pride that the Indian patriot marks this silent progress in the mill and hand-loom industries of India, which, next to agriculture, are the largest industries in this land. New mills have been started in Ahmedabad and Bombay within the last two years, largely as a result of the present *Svadeshi* movement. In the poor State of Baroda, too, this progress is marked. For more than twenty years the State worked a cotton mill in the capital town to give an object-lesson to the people and to encourage private companies to start similar mills. The call has now

been accepted, and a private company has at last been formed, and has purchased the State mill from our hand with the happiest results. Recently a second mill has been completed, and is about to start work, and a third mill is now under construction. More than this, the number of ginning factories, and other factories using steam, has multiplied all over the State, and the number of hand-loom has doubled in some towns. All the courser counts of yarn in the Indian markets are now mostly of local spinning; an insignificant fraction alone being imported from abroad. In the case of yarn of higher counts, however, the local manufacture falls much below the supply of the foreign mills. Muslin and finer fabrics can be imported much more cheaply, and in a more pleasing variety of design and colour, than can yet be locally produced; and the hand-loom of the East, once so famed for the *finesse* of their fabrics, have now dwindled into small importance. Prints and *chintz* from France, England and Germany are still extensively imported to meet not only the local demand, but also the demand of markets across the Indian Frontier in Persia and Afghanistan.

Thus, though there is reason for congratulation in the rise of our textile industries, there is yet greater reason for continued toil and earnest endeavour. We are still at the very threshold of success. Our cotton mills produced less than 600 million yards of cloth last year against over 2,000 million yards which we imported from other countries. Here is scope for indefinite expansion. We exported cotton of the value of 213 millions to foreign countries, and imported in return for this raw material cotton manufactures of the value of 390 millions. We are thus producing only a fourth of the mill-made cloth which the nation requires. And we should not rest till we are able to manufacture practically the total supply needed by our countrymen.

Gentlemen, the remarks I have made about the cotton industry of India apply to some extent to the other indus-

tries which require the use of steam. Bengal is known for its jute industry, which I believe is increasing year by year, and the number of jute mills has increased from 28 in 1895 to 38 in 1904. Northern India and the Punjab have some six woollen factories, whose produce has increased from  $2\frac{1}{4}$  million pounds in weight in 1895 to  $3\frac{1}{2}$  million pounds in 1904, and I have every hope that our countrymen, who have been so successful in cotton industry, will broaden the sphere of their operations, and take to jute and woollen industries also.

The silk industry is one of the most ancient industries of India, but declined like other ancient industries under the repressive commercial policy of the eighteenth and early nineteenth century. Some faint signs of improvement are, however, visible now. Tassar silk is manufactured in many parts of India, and quantities of it are exported to Europe. In Assam, silk still continues to be the national dress of women, and each family weaves silk *saris* for its own use. In Bengal some improvements have been recently effected by the adoption of scientific methods of testing the seed. In the Punjab the attempt to re-introduce the cultivation of silk worms has not been attended with marked success. In Kashmir the industry is indigenous, and the State is endeavouring to develop it. Much attention is paid to this industry in the advanced and enlightened State of Mysore. And in the State of Baroda I have been endeavouring to spread and develop the industry. The number of these filatures in India in 1904 was only 75, and the number of silk mills was only 11; but much silk is also produced as a cottage industry.

Gentlemen, so far I have confined myself to the textile industries; and I have scarcely time to refer at any length to the other industries of India. Brass and copper have been used for vessels in India from ancient times, but have been threatened lately by the cheap enamelled ironware of Europe. Aluminium is a new industry, and we are indebted to Mr. Chatterton of Madras for greatly developing it in India.

Recent geological surveys and investigations have brought to light the rich ore of iron which was lying concealed so long in Central India ; and there is a great scope for the development of the iron industry. Veins of iron ore are believed to exist in several places besides those where they have been yet explored ; and if only a few more enterprising companies like my friend Mr. Tata's spring up and prospect these mines, they have a hopeful future before them. If the quality of the indigenous coal is only improved and the means of communication made more easy and cheap, so as to considerably reduce the cost of transport, it would appear more profitable to smelt our iron in our own furnaces, rather than import large quantities from abroad. I am glad to find that the able geologist who discovered suitable iron ore for Mr. Tata's scheme, Mr. P.N. Bose, has been selected by your Chairman of the Reception Committee of this Conference. The scheme is still under the consideration of Mr. Tata's son, whom I had the pleasure of recently meeting in England. There were 89 iron foundries in India in 1904, and it is to be hoped that the number will rapidly increase in the near future.

Bengal is rich in coalfields, and out of the 8 millions of tons of coal, worth about 2 crores of rupees, raised in all India in 1904, no less than 7 millions of tons were raised in Bengal. These will seem to you to be large figures ; but what are 8 millions of tons compared with considerably over 200 million tons annually raised in England ? Our countrymen are engaged to some extent in coal-mining, though greatly hampered in the endeavour both by want of capital and want of technical knowledge, and I am glad the Indian Government have granted scholarships to some young Indians to learn practical coal-mining in England. The importance of coal consists in this—that its abundance makes every other industry on a large scale possible. Coal and iron have been the making of modern England, more than any other causes.

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These are the principal industries of India carried on mainly by steam, and for facility of reference I have put down the figures relating to them and a few other industries in a tabular form below :—

	1895.	1904.
Cotton Mills	... 148	203
Jute Mills	... 28	38
Woollen Mills	... 5	6
Cotton ginning, cleaning and Press Mills	... 610	951
Flour Mills	... 72	42
Rice Mills	... 87	127
Sugar Factories	... 247	28
Silk Filatures	... 89	75
Silk Mills	... 28	11
Tanneries	... 60	35
Oil Mills	... 163	112
Lac Factories	... 138	128
Iron and Brass Foundries	... 64	89
Indigo Factories	... 8,225	422

These figures will show you at a glance our present situation in relation to the principal industries carried on by steam in India. In some industries, like cotton, we are only at the very threshold of success, and produce only about a fourth of what we ought to produce. In other industries, like woollen and jute, we are indebted almost entirely to European capital and enterprise; we ourselves have scarcely made a beginning as yet. In a third class of industries, like sugar and tanneries, we have actually lost ground within the last ten years. While in a fourth class of industries, like iron, we are still almost wholly dependent on Europe, the produce of our own foundries scarcely supplying any appreciable proportion of the requirements of India. I repeat, therefore, what I have already said before; there is ground for hope but not for joy or elation; there are strong reasons for earnest and continued endeavour in the future to secure that success which we are bound to achieve if we are true to ourselves.

And there is one more fact which I would like to impress on you in concluding this brief survey of our present situation.



A great deal of attention is naturally paid to the mill industries of India, and to tea, indigo, coffee and other industries in which European capital is largely employed. We know, however, that the labourers who can possibly be employed in mills and factories form only an insignificant proportion of the industrial population of India. Very much the larger portion of that industrial population is engaged in indigenous industries carried on in village homes and bazaars. India is, and will always remain, a country of cottage industries. Where hundreds of thousands can work in mills and factories, millions and tens of millions work in their own huts; and the idea of greatly improving the condition of the labourers of India merely by adding to mills and factories is only possible for those who form their opinions six thousand miles away. No, Gentlemen; any comprehensive plan of improving the condition of our industrial classes must seek to help the dwellers in cottages. It is the humble weavers in towns and villages, the poor braziers and coppersmiths working in their sheds, the resourceless potters and ironsmiths and carpenters who follow their ancestral vocations in their ancestral homes, who form the main portion of the industrial population, and who demand our sympathy and help. It is they (more than the agriculturists, or the mill and factory labourers) that are most impoverished in these days and are the first victims to famines; and if your *Swadeshi* movement has brought some relief to these obscure and unnoticed millions and tens of millions in India, as I have reason to believe it has done to a perceptible extent, if it has created a larger demand for their manufactures, widened the sphere of their labours, and brought some light to their dark and cheerless homes, then the movement, Gentlemen, has my cordial sympathy. Help and encourage the large industries, but foster and help also the humbler industries in which tens of millions of village artisans are engaged and the people of India, as well as those who are engaged in the work of administration, will bless your work.

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### DIFFICULTIES AND HOW TO OVERCOME THEM.

Gentlemen, in saying all this, I do not by any means ignore or minimise our difficulties. We have to recover the ground which we have lost during the last two centuries. We, in our ignorance and poverty, have to compete with some of the richest, best trained and most skilful nations on earth. We, with our ancient methods, have to habituate ourselves to modern inventions, and then to beat those modern nations who made those inventions. It is a duel with Western nations with weapons of their own choosing; and with those weapons with which we are still unfamiliar, we must face and conquer those who are past masters in their use. With the produce of our infant mills and our infant iron foundries we must oppose the overwhelming flood of manufactured goods which England, Germany and America are pouring into India.

The danger of extinction with which our industries are threatened is therefore imminent. Keep to your conservative methods, cling to your orthodox ways of work, and your industries must perish. Such is the inexorable law of the survival of the fittest and such the admonition which a true Swadeshi movement ought to give you. If the rush of the steam engine and the whiz of electricity, combined with cheap and easy means of transport, have succeeded in dumping your bazaars with the cheap and attractive products of foreign marts, rise to the occasion and learn how to withstand this inroad with intelligent anticipation and skilful adaptation. Learn to force nature into a corner; accost her and bring out her inmost secrets. Harness her powers, tackle her energies, and make of her a handmaid unto man. Work nature to the relief of man's estate. Any competition between skill, capital and organised enterprise on the one hand, and ignorance, idleness and poverty on the other, can only have one result. Learn to combine and co-operate, learn the value of time and the use of money, and the chances of a fairer fight will eventually requite all your efforts.

Swadeshism can be a genuine economic force under the above conditions. It can be a potent weapon of usefulness if properly understood. There is no economic fallacy in that Swadeshi creed that aims at improving the indigenous arts. The genuine Swadeshi ought to secure the maximum of production at the minimum of cost. Patriotism demands that the greater cost and the slight discomfort of using indigenous goods should be cheerfully put up with at the outset. But remember that no such movement can be permanently successful unless it involves a determined effort to improve their quality and cheapen their cost, so as to compete successfully with foreign products. The most rigid economist will then have no flaw to find in your Swadeshi armour.

A single instance of the pitiable straits to which our industries have been reduced, on account of the difficulties mentioned above, will suffice. The export trade of Indian cane-sugar has now become almost a matter of past history. The invasion of German and Austro-Hungarian beet-root sugar has driven away Indian sugar from its own stronghold. In spite of the imposition of countervailing duties and extra tariffs the bounty-fed sugar from Europe beats the Indian refiner hollow on his own field; and it is curious to observe how the cane-sugar of India has suffered in the struggle. The reason is not far to seek. Laws can cure only artificial anomalies; the levy of extra duties can countervail only the adventitious advantage of bounties and subsidies; but what can remedy causes of mischief that lie deeper, ingrained in the very constitution of the Indian grower and inherent in the very conditions under which the Indian refiner has to work? The demand for consumption of Indian sugar is large enough; it is even larger than the local refiners can supply; yet the cost of production is so excessively inflated that it pays more to import the cheap beet-sugar, grown fat on foreign bounties, than to bring the products of her own growing into her markets. The growers and refiners pursue a process involving extravagant waste of raw material; and

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ignorant of the latest inventions of science or art, they adhere to the methods inherited from their sires with a hide-bound orthodoxy.

The same deficiency in improved methods and perfected machinery has also led to the ruin of the tanning industry of Madras. The curing and tanning of skins by an improved process in America has been found more suitable and more economical than the purchase of skins tanned in India. Similarly the manufacture of synthetic indigo, like other coal tar preparations, has effected a revolution in agricultural chemistry; and the quantities of artificial indigo that the German factories have dumped into the markets of the world at very cheap rates have a very depressing influence on the indigo trade of Bengal. The exports of indigo which in 1895 amounted to about 53 millions in value, dwindled down to the low figure of 6 millions 10 years later, and the decline has been so rapid that it has been a cause of alarm to an optimist of even a thorough Micawber type. Dyes of no less value than 75 lakhs of rupees were poured into the Indian vats from Germany, Belgium, and Holland in 1905; and these products of aniline and alizarine dyes have completely ousted the Indian dyers from their own markets.

It thus becomes imperative on all of us to endeavour to minimise this helplessness and enrich the industrial resources of our country. The trade returns of India are an instructive study. They tell us that in 1905, fully 69 per cent. of our exports were represented by bulky agricultural produce, which gave no employment to local skill and capital, save that employed in tillage. With regard to the total imports in that year, on the other hand, fully 59 per cent. of the entire amount represented manufactured articles, with reference to which we did not know how to supply our own wants, and had to depend upon foreign skill, foreign capital, and foreign enterprise. A fair criterion of the industrial development of a country may safely be sought in the proportion of its exports of manufactured goods to the ex-

port of raw material from the country; and secondly, in the proportion of its imports of raw material to the imports of made up or finished goods. The industrial prosperity of a country may be said roughly to vary directly with its exports of manufactures and imports of raw material; and inversely with its exports of raw produce and imports of manufactured goods. This is a safe and reliable canon of industrial economics. One more sad and prominent feature of the foreign trade of India is the constant excess of exports over imports which is not conducive to the prosperity of the people.

Our serfdom to foreign capital and to foreign enterprise can scarcely be more complete. Our railways are financed by capital from Europe; our mines are exploited by savants from America, and even in our daily household needs our dependence upon products of foreign marts continues from day to day. We are being fed and clothed, diverted and entertained, lighted and washed, warmed and comforted, carried and housed, by the foreign artisan. Our arts and industries are standing to-day on the brink of a precipice and are threatened with imminent extinction. The problem of saving the country from this perilous plight, and emancipating her economic slavery to the nations from the West, has become the one topic of absorbing interest; and to find out a cure for this malady has become the one anxious thought of every patriot and of every statesman. You, Gentlemen, have already bestowed your earnest attention to this subject, and I need therefore only make mention of the industries which appear to me to be capable of great progress in the immediate future. The list is appended below:—

1. The textile industry.
2. Carpenters and other wood work.
3. Iron, copper and brass works.
4. Work in gold and silver and jewellery.
5. Masonry and stone works.
6. Pottery and brick and tile making.
7. Dyeing.
8. Tannery and leather works.

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9. Rope weaving.
10. Cane and bamboo works, mat making and basket weaving.
11. Glass works.
12. Turnery and lac works.
13. Horn and ivory carving.
14. Embroidery.
15. Sugar refinery.
16. Tobacco curing, and
17. Oil and flour mills.

Out of these industries we might select, to begin with, those for which there is a large demand in our home markets, and whose raw material we have been at present exporting in ship loads for working them into finished products abroad. In the place of large exports of raw vegetable products our endeavour should be to send out large cargoes of manufactured and finished goods. In 1905 we exported oil seeds of the value of 106 millions of rupees, and imported oil of the value of 22 millions. Our oil factories in the Bombay Presidency are said to have supported only 76 operatives at the last census. There is an indefinite scope for the expansion of this manufacturing industry in the country. Oil pressers have diminished by 47 per cent. during the last decade, as it was found more profitable to export oil-seeds and import pressed oil from abroad, than to press it at home by crude and antiquated processes. Besides, as Dr. Voelcker has pointed out to us, to export the entire oil-seed is to export the soil's fertility.

Moreover, every year we export large quantities of wheat and other grain to be ground in foreign mills and import large quantities of flour for our use; while the wheat grinding mills in the Bombay Presidency afford no employment to more than 78 operatives, as the figure for the last census informs us. These are instances of the low state of our industries and of the difficulties under which they suffer. It should be your aim and endeavour to face and conquer these difficulties, and a wise and sympathetic legislation should help your effort and lead you to success.

Four years ago I made some remarks at Ahmedabad which, with your permission, I will repeat to-day.

“Famine, increasing poverty, widespread disease—all these bring home to us the fact that there is some radical weakness in our system, and that something must be done to remedy it. But there is another aspect of the matter, and that is that this economic problem is our last ordeal as people. *It is our last chance.*”

“Fail there, and what can the future bring us? We can only grow poorer and weaker,—more dependent on foreign help. We must watch our industrial freedom fall into extinction and drag out a miserable existence as hewers of wood and drawers of water to any foreign power which happens to be our master.

“Solve that problem, and you have a great future before you, the future of a great people, worthy of your ancestors and of your old position among nations”.

These are words which I spoke at Ahmedabad and I repeat them to-day, because we feel the importance of them, perhaps, more than we felt four years ago. We are at a crisis in our national history. The time has come, when we must make arduous and united endeavours for securing our industrial independence, or we shall sink again, perhaps for centuries to come. We must struggle and maintain our ancient position among the industrial nations of the earth, or we shall be betraying a sacred trust and be false to our posterity.

I am sure you will not accuse me of exaggerating the gravity of the present situation. I am sure you all feel, as I feel, that if we do not, at the present critical time, free ourselves from that industrial serfdom into which we have allowed ourselves to sink, we have no hope for the future. This, as I said before, is *our last chance.*

#### EXHIBITIONS AND CONFERENCES.

And now, Gentlemen, you will permit me to say a few words with regard to the work you have undertaken and the methods by which it can best be done. At a critical juncture

in our country's industrial history, the Indian National Congress conceived the *happy* idea of having an Industrial Exhibition in connection with their annual gatherings. From the very first, the Indian and the Provincial Governments rendered every assistance in their power to make these Industrial Exhibitions a success; and, I may add that all classes of the Indian population, Hindus and Mahomedans, Englishmen and Parsis, merchants and manufacturers, graduates, rich landlords and humble citizens, have worked harmoniously towards this common object. These annual exhibitions fulfil a double purpose. First they inspire manufacturers with healthy emulation, and enable them to make the products of the different provinces known to all India; and in the second place they enable traders and dealers in articles of daily use to obtain accurate information, and collect articles from all parts of India for the use of purchasers in every province and town. These exhibitions have been a success; but let us not deceive ourselves. Compared with the wealth, the variety, the magnitude of Western products, as I have seen them abroad, the results we have achieved here are meagre indeed. An exhibition like this simply serves to emphasise our backwardness in utilizing the resources at hand. Let us never be satisfied until we attain a standard of perfection that will bear comparison with the Western world. With the sympathetic co-operation of the Government, and the quick intelligence of our people, there is no reason why such a result may not be achieved within a generation or two.

Last year, Gentlemen, you took a new departure. Not content with these annual exhibitions, you held an Industrial Conference, and the First Conference was held under the guidance and presidentship of my Revenue Minister, Mr. R. C. Dutt. The Conference arranged that its work should proceed all through the twelve months instead of being transacted once in the year. It appointed Provincial Industrial Committees at Calcutta, Bombay, Madras, Allahabad, Lahore, and Nagpur. And it also appointed a permanent



Secretary and Under-Secretary with head-quarters at Nagpur to compile information, to carry on correspondence, and to help the Provincial Committees in their work all through the year. I am glad to find that this central establishment has not gone to sleep over its work ; within this closing year the Secretary and Under-Secretary have collected subscriptions which have more than covered the year's expenditure ; they have published in a handy form a report of the Conference, embodying all the valuable and instructive papers which were read at the time ; and they have compiled a Directory, —not complete or exhaustive by any means but a fair beginning,—describing different industries in the different parts of India. They have also published a very interesting report of the work done during this year in all parts of India.

Gentlemen, all this is a good outturn of a first year's work, but you should not be satisfied with this. A greater progress is expected from you in future years. The weak point in the Conference organisation seems to me that the Central Office is not in sufficient touch with the Provincial Committees, and is not able to render sufficient help to those Committees to develop the industries of the different provinces. Besides Provincial Committees, you require District and even Town Associations for closer touch with the masses. India is a country of vast distances ; and it takes more than a day and a night to travel from Nagpur to some of the provinces. While the Central Office at Nagpur can do much to help the outlying provinces, the provinces can do more to help themselves. By such harmonious co-operation towards a common object, I hope to see the work of the Industrial Conference show a continued progress from year to year. A central organization is needed to co-ordinate all the endeavours that are being made in all parts of India to promote home industries ; and the Industrial Conference, with its central establishment and Provincial Committees, was not established a day too soon.

## II. H. THE GAEKWAR'S INAUGURAL ADDRESS. 19

### GENERAL EDUCATION.

And now, Gentlemen, I desire to place a few practical suggestions before you, such as, from my own knowledge and experience, occur to me. The first and the most important means of promoting our industries is to spread general education amongst the masses. Great and far-reaching changes might be made in the educational system of the country, and I am of opinion that no ultimate solution of our problem will be reached until schools have been provided in every village, and education is taken to the very threshold of the people; until, in fact, education, at least in its primary grades, has been made free and compulsory throughout the land. I am, indeed, gratified to learn that the Government of India has already under consideration the policy of making primary education free.

### COMPULSORY EDUCATION.

The experiment of free and compulsory education is a novel one in this country; and yet its novelty must not scare us from our duty. I am not, indeed, prepared at this time to recommend the example of some of the socialistic communities of the West in providing free breakfasts, free baths, free boots and everything else but free beds. I have, however, endeavoured to introduce compulsory education throughout the State of Baroda, and hope to see my people benefited by it. The measure was being worked with satisfactory results in one part of the State for a number of years. Emboldened by the success of this experiment, I have decided to make primary education compulsory throughout the State and absolutely free.

### TECHNICAL EDUCATION.

Of scarcely less importance at this time of the day is the need for Industrial Education. I must confess that it is my recent visit to Europe and to America that has impressed me most with the immense importance of technical education in promoting the industries of nations. I may state without exaggeration that education has undergone a complete

revolution in the West within the present generation. The great armaments of the Western nations, their vast armies and navies, do not receive greater attention and greater solicitude in the present day than that education in industrial pursuits which befits them for the keener struggle, which is continually going on among nations for industrial and manufacturing supremacy.

Among the nations on the Continent of Europe, Germany takes the lead in industrial enterprise; and among the many technical institutes of that country the King's Technical High School at Berlin is the most famous. A large staff of professors teach over 1,500 students, and applied chemistry in oils and colours as well as dyeing, bleaching, printing on cloths and silks, and leather tanning are taught on a scale unequalled in any other country on the Continent.

France is endeavouring to foster her industries and manufactures in numerous institutes. The *Musee des Arts et Metiers* of Paris has an extensive collection of machines and models of machines, and Science and Arts classes are held there on important technological subjects. The French Government manage the Sevres Royal Porcelain Factory and the Gobelins Tapestry Manufactory; and frequent exhibitions are held every year in the Grand and Petit Palais of Paris.

Austria is not far behind, and Vienna has technical schools on a smaller scale, each teaching some branch of a technical art; Italy has her technical academies; and a polytechnic institute, planned after the Cassanova Institute at Naples, might serve anywhere to collect the best craftsmen and the most promising apprentices under the same roof and extend the moral influence of the teacher to the pupils. All the experts of art would be collected there, and interchange ideas about their trade deficiencies and trade difficulties.

In London the City and Guild's Technical College, the County Council's Schools of Arts and Crafts, under Principal

Lethaby, and the several Polytechnics are among the many institutions where a practical training in arts and industries is imparted to the people.

The new universities of Manchester, Birmingham and Leeds pay special attention to technical education as the older universities of Oxford, Cambridge and London take up liberal and classical education. The Municipal School of Technology at Manchester is a monument of the enterprise of that great manufacturing town, and teaches mechanical, electrical, municipal and sanitary engineering, technical physics, industrial and general chemistry, bleaching, dyeing, printing and finishing of textiles, paper manufacture, metallurgy and various other subjects. Some students from Baroda are engaged in the study of acids and alkali manufacture and plumbing and sanitary engineering in this school.

But of all the countries which I have recently visited, it is America where I found the highest development of industrial education. Every single State in the United States has a State college, where technical education is given to students *absolutely free*. No fees are charged in these State colleges, because the proper training of citizens in technical arts is considered a matter of national importance, and lands and annual grants are assigned by the States for the maintenance of these colleges. Every State college teaches agriculture and engineering, and also gives some training to the students in military tactics. Other subjects are also taught according to the resources of these colleges.

Besides these State colleges there are some 43 privately endowed technical institutes all over the United States, where engineering is taught in all its branches, civil, electrical, mechanical and marine; architecture, drawing, modelling and textile industry are also among the subjects taught. The great Institute of Technology at Boston, with its 2,500 students, the Armour Institute at Chicago with its 2,000 students, and the Pratt Institute at New York with its 1,500 students

are the best known among these privately endowed technical institutes.

I need hardly add that the great universities like Harvard, Yale and Columbia also teach engineering in all its branches ; and, what will surprise you more, almost every high school has classes for manual training, comprising carpentry, smithy, and machine shop.

I have not yet visited Japan, but we all know what Japan has done within the lifetime of one generation. Her victories in the battlefield have lately brought that wonderful land among the foremost nations on earth ; but the victories of Nanshan and Mukden are not more brilliant than the triumphs of her industries achieved by a system of technical education which leaves very little to be desired.

#### MANUAL TRAINING.

My second suggestion to you is that, besides establishing technical schools, you should endeavour to introduce some manual training in the ordinary schools. The training of the eye and of the hand at an early age is useful to all, even to those who have not to support themselves by manual industry in life. Early lessons in drawing and modelling, simple instructions in carpentry and smith's work, are good for all students in all ranks of life. Physicians and psychologists tell us that such exercises, by introducing a variety in the course of studies, really refresh and help the brain and make boys and girls more capable of acquiring both learning and arts. And, moreover, to attach some industrial classes to our ordinary schools would have the healthy effect of giving a complete and not one-sided education to our children. The richer classes would be brought more in touch with the humble industries ; the poor classes would acquire that skill and facility in handling tools which can be only acquired at an early age ; all people in all branches of life would be impressed with the dignity of manual labour more than they do now in India ; and your great endeavour to promote

the industries of the land would be greatly helped when the nation receives an elementary technical training in schools. At the same time it is necessary to bear constantly in mind that no amount of specialised training in manual arts can fill the place of that liberal education and general culture which should serve as the necessary substratum for all kinds of learning. Technical training is a supplement, but not a substitute, for general education, and should never be turned into a fad.

#### EDUCATION ABROAD.

I have tried to impress on you, Gentlemen, the importance of founding technical schools and of introducing manual training in our ordinary schools throughout India. Years will, however, pass before this can be done on an adequately extensive scale, so that India can take her legitimate place among the nations of the earth in industrial education and mechanical inventions. It follows, therefore, that for years, and perhaps generations, you must send your young men to Europe, America, and Japan for that complete industrial training which they cannot yet receive at home. Make no mistake, and let no time-honoured prejudices deter you from travelling to other parts of the earth, and receiving that new light, that new culture, those new ideas, which even the most gifted and advanced nations always receive by mixing with other nations, and which India needs, perhaps, more than any other civilized nation. The healthy results of foreign travels, and of comparing notes with foreign nations, are already manifest in India in every department of life within the last fifty years. Nothing impressed me more upon my recent return to India than the changed attitude of many of my countrymen towards foreign institutions. Men of all ranks have been eager to learn my impressions of Western nations. Such a spirit of enquiry is always healthful if it proceeds from a sincere thirst for knowledge. I was much interested in learning while in America that some two or

three thousand students every year go abroad to absorb the best of European methods in Education and in Commerce; while the National Government sends men to all parts of the world to study the products of other lands. England, Germany and France, with all their commercial prestige, do not hesitate to send inquirers to foreign parts. Coming nearer home, we find that hundreds of Japanese young men complete their education in France, Germany, England and America. Such is the desire for knowledge, and the whole-heartedness of the latter, that not only do they acquire a special education in whatever subject they may be engaged, but they also provide themselves with the means of livelihood, not shrinking from the humblest occupations of life.

Japan profited most by sending out her youths to the seminaries of Europe. She owes her present greatness to that illustrious band of her scholar statesmen, who imbibed the first principles in the science of politics and the art of government at the universities of Gottingen and Leipzig. She is to-day the mistress of the Eastern seas because of her student sailors, who acquired their first lessons in naval warfare in the docks of Tilbury and Portsmouth. Her battles are fought and won by her soldiers who got themselves initiated into the mysteries of manœuvring and the secrets of stratagem on the plains of the Champ-de-Mars and Rastadt. And she bids fair to assume the supreme place in the trade of the Orient on account of her scholar financiers, who have rubbed shoulders with bankers in the counting houses of London, Berlin and New York. Has the world ever seen a nobler instance of young men architecturing the fortunes of their motherland? Can we conceive a higher example of patriotism for India's sons to emulate? Let us follow their spirit of self-sacrifice and devotion; let us hold up their ideal of national unity and social equality, learn eagerness to acquire the newest methods in all walks of life; imitate their perseverance and patient toil; and we may yet save the fortunes of our country.

I have learnt with pleasure that an earnest and patriotic worker of this province, Mr. Jogendra Chandra Ghose, the worthy son of a worthy father, has organized a scheme for sending young men to Europe and America for education; and that a large number of students have already been sent in accordance with this scheme. Nothing gave me greater pleasure, while abroad, than coming in touch with several Bengalis who were studying in Europe and America. Although far away from India, they had the kindest and most patriotic feelings for their native land. India is to be congratulated in having such men. This policy has also been pursued by the State of Baroda for many years past, and young men, educated in Europe, at State expense, are now serving the State with credit, or finding profitable employment in other parts of India. Several young students have lately been sent to England and Germany, America and Japan; and a scheme is now under consideration to send a limited number of students at regular intervals, mainly to learn the methods of modern industry.

Gentlemen, India to-day is at the parting of ways, and there are great possibilities before her. The people of Bombay, for instance, are looking forward to the use of electricity generated in the Western Ghats for working their mills. The people of Madras are looking forward to the experiments made in "tree-cotton." All India looks forward to the happiest results from the Research Institute for which we are indebted to the late lamented Mr. Tata. There is stir in the air; and the people are showing signs of awakening. This is hopeful; but let us not forget that years of patient toil are before us, that it is only by patience and perseverance that we can ever succeed in competing with the West in industrial pursuits. We need the spirit of determination, of courage, of confidence in ourselves and in each other; we need to distinguish between essentials and non-essentials, between the spirit that vivifies and the letter that kills. Let our energies be not distracted in small things.



I now desire, with your kind indulgence, to add a word on the lessons that seem to me to arise from the experience of different nations—lessons which are pertinent to India at this juncture. Turning to ancient Egypt, once the centre of the most advanced civilization of the time, we discover that vast resources—agricultural and mineral—are not alone sufficient to produce a cultured and permanent civilization; though the foundation of all stable civilizations must fall back in the last analysis upon the natural resources of the country. Egypt in the ancient time had abundant resources, but failing to note the value of human life, failing to conserve the interests of the working masses, she sank from the pinnacle of power and culture into political servitude and academic decay. The nation that despises its humblest classes, that provides for them no opportunity to rise in the social scale and in self-esteem, is building its house upon the sand. The wealth of a nation is the quality of its manhood.

Greece fell from her eminence not from any failure of philosophical or æsthetic or political insight; in these directions she has been the chief source of inspiration for the whole Western world. Pericles, Plato and Aristotle are still household names in the West. Athens faded away like a fragrant memory because she failed to look to the economic bases of her prosperity. Had she taken pains to utilize her splendid maritime location for the development of commerce and industry; had she confided her commercial affairs to her freemen instead of her slaves; had she applied the sagacity of her statesmen to the formation of a sound fiscal policy, the story of Athens might have had a different *denouement*. But she wasted her mineral resources, and expended large sums in the erection of great temples of worship and art and learning. Far be it from us to suggest any criticism against a civilization which has been the fountain head of all subsequent growth in the culture of the West. I would simply point out that without a permanent and stable economic policy, no civilization, however enlightened, can long endure.

This is the message of ancient Greece to modern India. Be careful of large expenditures, either individually or collectively, which are unproductive. Bid her people forget their caste and tribal prejudices in the common effort to uplift the fortunes of India; bid them find expression for their religious enthusiasm in practical co-operation for the uplifting of humanity—of the human spirit in the temple of God. Bid them be free men, economically, socially and intellectually; and no power under Heaven can long keep them in servitude.

Rome, too, has its lesson for India. In the complex and far-reaching series of disasters, which led to the downfall of Rome, it would be difficult, indeed, to designate any one factor as the premier cause of the catastrophe. But of this we may be sure, that the highly centralised and paternalistic Government which developed under the later Cæsars, was a potent cause of weakness to the Empire. Private initiative and individual responsibility gave place to State operation of manufactures and industry. Insufficient currency and military oppression drove the husbandman from his plough and the merchant from his counter. The people looked to the Cæsar for corn, and out of the public treasury the hungry were fed, if they were fed at all. The Emperor ruled by force of arms; manufactures were operated by a system of forced labour under the strictest surveillance of the State; the civilian was forced into idleness and vice; the masses into pauperism and dejection. The national spirit decayed, and Rome fell an easy prey to the ravaging hordes from the North.

At this crucial period in India's emancipation, we shall need to keep constantly in mind the failure of Rome. No permanently sound and stable development can occur unless we take pains to educate the masses of our people to a sense of their paramount importance and dignity in the social structure. I conceive it to be the prime duty of the enlightened and well-to-do amongst us to rouse, to stimulate, and to educate the lower classes. We should help them to help

themselves. But ever let us beware of paternalism. Not charity but co-operation is the crying need of the hour.

Let our people, as rapidly as possible, be educated in the principles of economics, and let special pains be taken for the development of an honest, intelligent, *entrepreneur* class who will be content to organise and manage our new industries without sapping their life by demanding exorbitant profits.

Ancient India, too, has lessons for us. I have already spoken of India's rich products and her brisk trade with the West in ancient times. But her mechanical inventions were slow because mechanical work was left to hereditary castes, somewhat low in the scale of society. Our sculpture does not compare favourably with the sculpture and architecture of ancient Greece, and our mechanical progress does not keep pace with the mechanical inventions of modern nations, because our intellectual classes have been divorced for centuries and thousands of years from manual industry, which has been left to the humbler and less intellectual classes. In literature and thought we need fear no comparison with the most gifted nations on the earth. The genius for craftsmanship is also among the people, as is evidenced by the ingenuity and skill of our artisan classes. Make industrial pursuits the property of the nation, instead of the exclusive possession of castes; let the sons of Brahmans and of learned Moulvies learn to use tools in their boyhood; let every graduate, who feels a call towards mechanical work, turn to that pursuit in life instead of hankering after salaried posts, and I am convinced the national genius will prove and assert itself in industries and inventions as well as in literature and thought.

Turning to the Western world of modern times we discover lessons of the most importance for India at this time. As I look back over the last several centuries which have raised the nations of the West from the darkness of mediævalism to their present high degree of civilization,

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it seems to me that four historical movements are plainly discernible as important factors in that development.

The first movement to which I refer is the capitalistic programme of the last few centuries. I do not need to dwell before such an audience as this upon the advantages of a capitalistic organization of industries, with its attendant systems of credit, banks and exchanges, with its economy of production and its facility of distribution. In the scientific application of capital we still have many things to learn from the nations of the West.

For this reason I am firmly convinced that we need to devote large sums to the founding of chairs of economics in our colleges, and to the training of our young men in the subtle problems of finance. Let the brightest of our young patriots be sent to Western universities to master the principles of economic polity.

The second movement in the West is the taking of social, political and commercial affairs, which are purely secular in nature, out of the hands of the priests. In the 13th century the Church of Rome and her minions dictated not only matters of religious import, but reached out in many directions to control all the relations of life, both individual and collective. For three centuries the popular will struggled against the secular tendencies of the Church, until led to open revolt by Martin Luther. Since that revolt the principle has been firmly established, and is held with special vigour in America, that the realm of the Church is in matters of moral and metaphysical import, and that social, political and commercial relationships must be left to the individual consciences of those who participate in them. And in this connection I merely desire to point out that in so far as India's religious ideas tend to keep many of our brightest and best minds out of practical affairs, out of the scientific, political and commercial movements of the time, by so far do those religious philosophic systems stand in the way of her progress towards economic independence. Why have the people of India been

tardy in grasping the scientific principles of Western industrial organisation? I shall not presume to answer the question at any length, but content myself with suggesting that we must, as a people, look well to the religious and social foundations of our national life.

Break the monopoly of caste prerogatives and social privileges. They are self-arrogated, and are no more inherent in any one caste than commercial predominance or political supremacy in any one nation. Learn the luxury of self-sacrifice; elevate your brethren of the humbler castes to your own level; and smooth all artificial angularities. Always appraise action more than talk, and ever be ready to translate your word into deed.

I desire in the next place to call your attention to the development of national spirit. Throughout Europe for the last two thousand years there has been constant progress in the unifying and the solidifying of national life. Petty States and warring principalities have given place to strong, compact and homogenous nations, each possessing decided national characteristics, and each working through the patriotic impulses of all its people for the preservation of the national ideal. Now I find in my reading that the most frequent criticism offered against us as a people by candid critics is that we are disunited, many-minded, and incapable of unselfish co-operation for national ends. If this criticism is true, if it is true that India is a mass of small, heterogeneous peoples unfitted for independent national existence, then it behoves us as intelligent men and patriots to put in motion the principles of unity and co-operation. To this end I favour the adoption of a national speech and the inculcation of a national spirit.

And the last movement to which I would direct your attention is the development of science in Europe during the last hundred and fifty years. The story of that development reads like a romance of the olden time. Within that period have been developed railway, steam ships, electric telegraphs,

the telephone, friction matches, gas illuminations, knowledge of electricity in all its multiform applications, phonograph, Rontgen-rays, spectrum analysis, anæsthetics, the modern science of chemistry, the laws of molecular constitution of matter, conservation of energy, organic evolution, the germ theory of disease, and many others of the utmost practical importance in modern life.

I submit, my friends, that India's part in this wonderful movement has been shamefully small. Can it be true, as one writer has said, that some "strange feat of arrest, probably due to mental exhaustion, has condemned the people of India to eternal reproduction of old ideals"? I cannot believe that the intellectual power of India is exhausted, nor can I believe that her people are no longer capable of adding to the sum of human knowledge. We have an intense and justifiable pride in the contribution of our sages of bygone days to the philosophic, the literary, and the artistic wealth of world. It should be our chief pride, our supreme duty, and our highest glory, to regain the intellectual supremacy of the ancient days. The atmosphere of the West is throbbing with vigorous mental life. The pursuit of *new* truth is the first concern of every stalwart mind of the West, while the mass of our people are content to live stolid, conventional lives, blindly following the precepts of the fathers rather than emulating the example they set of intellectual independence and constructive energy. I cannot do better than close my remark with those fine lines of the poet Mathew Arnold:—

The East bowed low before the blast  
 In patient, deep disdain;  
 She let the legions thunder past,  
 Then bowed in thought again.

I would not for a moment have you think, my friends, that I return from the West a convert to Western ideals, or in any sense a pessimist concerning the future of India. There are many defects in the Western civilization that no impartial student of affairs may ignore. The evils that have grown

up in the centralizing of population in the great industrial cities constitute, in my judgment, a serious menace to the future of those races. There are weighty problems of administration, of morals, of public health, which the West, with all its ingenuity, has not been able to solve. There is the internal conflict between capital and labour which is becoming more acute as time goes on. Nor can one visit the great commercial centres of the West without feeling that the air is surcharged with the miasmatic spirit of greed. Everywhere the love of display and the sordid worship of material wealth and power has poisoned the minds of the people against the claims of the simple, homely life, which the Indian, in his love for the things of the spirit, has cultivated since history began.

It may be the mission of India, clinging fast to the philosophic simplicity of her ethical code, to solve the problems which have baffled the best minds of the West, to build up a sound economic policy along modern scientific lines, and at the same time preserve the simplicity, the dignity, the ethical and spiritual fervor of her people. I can conceive of no loftier mission for India than this, to teach philosophy to the West and learn its science; impart purity of life to Europe and attain to her loftier political ideal; inculcate spirituality to the American mind and imbibe the business ways of its merchant.

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## THE HON. MR. VITHALDAS DAMODAR THACKERSEY'S PRESIDENTIAL ADDRESS.

GENTLEMEN,—

It was with much diffidence that I accepted the invitation of the Executive Committee to preside over the deliberations of this, the second Session of our Industrial Conference. While I considered it a very great honour which the Committee wished to confer on me, I yet felt that it was one to which I could not hope to do as much justice as, for instance, His Highness the Maharaja Gaekwar, who has just addressed to you words of ripe wisdom from his experience of many lands and his study of many systems, or the 1st President, Mr. Romesh Chunder Dutt, whose large administrative experience, wide reading, and sound knowledge of economic and industrial history, pre-eminently qualified him to guide this Conference in the great work that it has undertaken. I allowed myself, however, to be persuaded into accepting the important part that it was proposed to assign to me in connection with this year's meeting, by the consideration that the Conference, being devoted to the advancement of industries and commerce, may be pleased to give indulgent hearing to one who is engaged in these activities, and who may, therefore, be expected to know the more practical aspects of some of the many problems which this Conference may help to solve. I shall not detain you further with personal observations, and for the few that I have already made I offer you my apologies.

Gentlemen, whatever doubts might have been felt last year as to the utility of holding an Industrial Conference, I am sure they have been dispelled by the experience that we have already gained. The meeting of the Conference and the circular letters of the General Secretary, the tours made by the Assistant Secretary in Madras and Northern India, of which a very interesting account has been supplied to us, the admirable report of the Proceedings of the last Confer-



ence, and Mr. Mudholker's excellent summary of industrial activities in the country during the year, are all proofs of the success that has attended the efforts of the promoters of the Conference to create public interest in industrial questions. At no period in our history have the thoughts of the people been concentrated so much on the development of Indian indigenous industries. The objects of the Conference have evoked the warm sympathies of Government and of the official and non-official European community, which I consider to be a happy augury of the success of our industrial movement. Differences may arise, they must arise now and then, between the Indian and non-official Anglo-Indian communities, as regards political and administrative questions with which, however, we have nothing to do on this platform. But on industrial and economic questions there is a very extensive field for co-operation and fellow-feeling between them. The Englishman who invests capital and spends his energies in Indian industries suffers equally with the Indian producer from ignorant interference from England, the thrusting of inequitable financial burdens on the tax-payer in India, and the adoption of measures which lead to discontent and unsettlement of the minds of the people. I rejoice to see that this is coming to be recognised in an increasing degree, and I may mention as an illustration the strong and unanimous opposition which Anglo-Indian opinion offered, in support of Indian interests, to proposals of one or other of these kinds made in recent years. I am firmly convinced that the promoters of this Conference have displayed true statesmanship and deep insight into the realities of the situation in extending their appeal for sympathy and support to Government and the non-official European community; and the response from these quarters which has been received and which is set forth fully in the excellent report of the last Conference is, I think, one of the brightest and most hopeful features of public life at the present time. I earnestly pray that the

feeling of harmony thus begun will grow in strength and power as the years pass, and that Englishmen and Indians will appreciate to a larger extent the value of mutual co-operation for the material advancement of the country and in the amelioration of the unspeakably wretched condition which is the lot of millions of the Indian people. While on this subject I should not omit to say a word of acknowledgment of the able and extremely sympathetic manner in which the new Commercial and Industrial Department of the Government of India has been administered by the retiring Member, the Hon'ble Mr. Hewett, and Mr. W. L. Harvey, the capable Secretary in charge of the Department, and to express the hope that under the new Member, who is well-known and justly esteemed in this country, the Department will gain further the confidence and good-will of the industrial and commercial public. The appointment of the Stores Committee and the resolution announcing its appointment afforded conclusive proof of the great sympathy felt by the present Government of India for the cause of our industrial advancement, and the whole country looks to His Excellency the Viceroy, of whose strength of principle and devotion to duty it has had ample proof, not to allow interested intervention to frustrate the just and righteous object with which the Committee was appointed. The Committee has made its report, and I would humbly suggest that the report should be published at once to enable the public to express its opinion on the recommendations contained in it. The value of such enquiries extends beyond their immediate results. I respectfully submit that we are entitled to have an opportunity of expressing our opinion on the recommendations, before the Government in England or India pronounces its final decision. This is a matter where Indian and Anglo-Indian interests are identical, and this Conference will have the whole country at its back if it elect to approach Government with a prayer for the immediate publication of the report of the Indian Stores Committee.

## FOREIGN CAPITAL.

I have referred to Englishmen who have invested capital in Indian industries, and I may not inappropriately make some observations here on the much-debated question of Indian Capital *versus* Foreign Capital. The great mistake to be guarded against is that, because certain capital used in India is foreign, it therefore must do harm to the country. It has, of course, to be considered that we ought not to pay too high a price for it. Let us take the instance of Japan, an Asiatic people who have risen to greatness on account of their practical genius, whose industrial conditions are similar in many respects to our own, and whom we are all naturally anxious now-a-days to emulate. All the great statesmen and patriots of Japan are eager to attract foreign capital to their country for purposes of industrial development. It is because they feel that, notwithstanding their skill, enterprise and ability, they are greatly handicapped owing to want of capital. At the same time, when they speak of attracting foreign capital, they do not mean to allow all the profits of the industry to go out of the country. They will not pay more than a reasonable price for it. Their position as an independent State, of course, enables them to regulate the conditions under which foreign capital will be free to engage in the development of the country. But in our country, where the open-door policy prevails to the fullest extent, and where already there is a very large amount of foreign capital invested—and I admit there is a very large field for it—it is necessary for us to form a general conception of the limits within which its application is beneficial. Let us take our Railways. The capital outlay from the commencement on open lines, lines partly open and on lines wholly under construction, amounted at the close of the calendar year 1905 to over Rs. 370 crores. Without maintaining that the Railway policy of the Government of India has always been dictated solely by the productive needs of the country, I may say that we cannot be enjoying

all the advantages of these Railways, the ability to cope with famine, the easy transportation from one part of the country to another, and not least of all our assembling here to-day for the purpose of advancing the interests of the country in various directions, but for the fact that we were able to get this large capital at a comparatively cheap rate of interest from England. Indeed, it is easy to see that the spirit of nationalism that is inspiring our movements to-day would have been impossible but for the network of Railways which, annihilating distance, brings the Punjab and Madras, Assam and Baluchistan, near to each other, and binds the whole country by the common bond of economic and national interests. Apart from strategic Railways, everybody is agreed as to the immense benefits which have been conferred on the country. Even now there are several new lines which may be laid down with the greatest benefit, and which will tap new country and which may give scope for Indian capital, if we can be satisfied with a return of 4 per cent. on the outlay. If we cannot afford to invest money at that rate, is it not desirable that those who are able to do so should lend us the money? Though in the beginning Railways may not earn much, experience shows that their earning power steadily increases with the progress of the country. If Government had allowed foreign investors to construct Railways unconditionally, the high profits and the unearned increments thereof would have gone out of the country for ever to enrich the original investors after the manner of the American magnates who have the good fortune to be the sole owners of Railways uncontrolled by Government. We owe, therefore, a deep debt of gratitude to those who, with clear foresight, kept in view, while arranging terms with the Guaranteed Railway Companies, the ultimate object of nationalizing them after allowing the investors to take the full benefit of the Railway for a limited period, generally of twenty-five years. It is thus that most of the main lines have already become State lines, and that the few remaining ones

will become so in course of time. The system of the repayment of the value of Railways by annuities on the termination of the period fixed by their contracts, obviates the difficulty and inconvenience incident to the raising of heavy loans. How profitable this policy of nationalizing the Railways has turned out to be may be gauged by the case of the East Indian Railway purchased by the State in 1880. In 1905, the net earnings on this line amounted to Rs. 482 lakhs. Out of this amount 87 lakhs were paid as interest charges on borrowed capital and Rs. 216 lakhs as annuity to the original shareholders on the basis of repaying the whole purchase amount before 1953. There still remains Rs. 160 lakhs as net yearly gain to the State, while, after 1953, the yearly gain will be trebled, taking the present revenue as it is. Here, then, is an instance of the right use of foreign capital. But 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 another and a less favourable aspect of the question of the investment of foreign capital. It is impossible to estimate accurately the amount of wealth that goes out of the country in this manner, though an approximate idea can be had of it from the excess of our exports over our imports, after omitting Government transactions. It must be remembered that so much of this amount as represents merely the interest on borrowed capital, should be not regarded in the light of a drain from the country. It is in such investments as these that we find cause for complaint. In such cases I cannot but think that it would be to the permanent good of the country to allow petroleum to remain underground and the gold to rest in the bowels of the earth, until the gradual regeneration of the country, which must come about under British rule, enables her own industrialists to raise them and get the profits of the industries. A country which maintains a population of thirty crores is not likely to let about one lakh

of persons starve, and this is the number of wage-earners benefited by these industries. The price paid is much too great for the advantages accruing from them to the country. That such is the view of all impartial people who are sincerely interested in the material advancement of the country, is proved by the following passage which I quote from the excellent paper which Mr. Holland, the Director-General of the Geological Survey, read before this Conference last year. Speaking of the successful exploitation of the petroleum fields of Burma, he 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 such an unnecessary and undesirable tax as long as those in the country who possess money will not risk their reserve fund in industrial purposes".

#### INDIAN BANKS.

I think, however, that indigenous capital will not be quite enough for financing the enormous and ever-expanding trade of the country and for accelerating the progress of our material and industrial regeneration. For these purposes we require as much capital as we can, and if we can get it cheaper in England than in India, I for one do not see why we should not avail ourselves of it. No country in the world can make much progress in industrial directions without plenty of capital. The problem of India may be briefly stated as follows:—

Our immense trade, our comparatively small capital, the fixed open-door policy of our Government, and the absence of power to control our financial policy,—these are the main factors of the situation, and the question is how best we can, under these conditions, develop our industries. We cannot do without foreign capital; it will be extremely short-sighted to reject it on sentimental grounds. We must avail ourselves of it, but we ought to take care that we do not pay

more for it than other nations. We have to consider what is the best way of bringing foreign capital to India. It is necessary for this purpose to offer foreign capitalists absolute security for their money, in order to get it as cheaply as possible. Government is in a position to do this, and hence Government is able to borrow from them as much as it likes on easy terms. There are few private individuals in India who can offer security necessary for this purpose. Smaller capitalists there are in plenty, but each of these by himself can be of no use in this matter. But what individuals cannot do singly, they can do by combination. Joint-Stock Banks being the results of such combination offer the only means of bringing foreign capital into the country at easy interest. Till recently there have been no such Indian Banks among us, with large enough capital for the purpose. It is, however, a matter for satisfaction that two such Banks have been started in Bombay within the last few months. These Banks at present intend to finance the internal trade of the country for which there is a wide scope; but we hope that after some time they may feel their way to extend their operations to foreign exchanges, and thus take advantage of foreign capital as the other Exchange Banks are at present doing. We want more of such Banks in order that the present situation may be ameliorated. The Presidency Banks are not allowed to borrow from foreign countries. The Exchange Banks do trade with foreign capital, but as their shareholders and directors are outside of India, the immense profits of the trade go to them and not the people of India, who get only the bare interest on their deposits, running to over sixteen crores in these Banks. Indian Banks with large capital have, therefore, an important function to perform in this and in other ways, and I hope and trust that the movement begun in Bombay will expand and flourish. There is one other suggestion which I should like to make before leaving this part of the subject. It may happen in many cases that although we may not be able to provide

all the capital required for a new industry, we may yet be able to supply a portion of it, and so save some portion of the profits of the industry from leaving the country. But few foreign companies ever give a chance to Indian capital. They like to do all the financing themselves and do not even place their shares in the Indian market. This is unfair, and I would suggest 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 countries, that the time for applications for shares should be the same, and that allotment must be made at the same rates and on the same principles. This is the least that our Government should do under the present circumstances.

#### SWADESHI MOVEMENT.

Gentlemen, you will, perhaps, expect me to refer here to the Swadeshi movement, and I hasten to satisfy that expectation. Whatever Bengal might have done or failed to do during the last twelve months, she has undoubtedly given an impetus to the Swadeshi idea. All over the country to-day, among young and old, rich and poor, men and women, high caste and low caste, the word "Swadeshi" has become a household word, and the spirit of it too, we may hope, is well understood. Gentlemen of Bengal, on behalf of the whole country, I tender you our hearty thanks for this valuable result, which is wholly due to your enthusiasm in the cause of the motherland. I am not one of those, Gentlemen, who sneer at enthusiasm. Enthusiasm is divine, and without it, even in regard to the industrial regeneration of the country we, can achieve but little. You have applied the life-giving spark to the slumbering spirit of Swadeshim in this land, and yours is the honour of concentrating the national mind on the work of industrial development. It is inevitable that in a time of excitement and distress words might be spoken and things done which in calmer moments



might not commend themselves to our sober judgment. I am referring solely to the effect of your enthusiasm and self-sacrifice on the whole of India, even among those who did not and could not see eye to eye with the Bengalis on the question of partition and the subsidiary questions connected with it.

#### AGRICULTURAL INDUSTRY.

Gentlemen, we have got the Swadeshi idea firmly implanted in the national mind. We have now to consider what our programme should be for the near future. We cannot do everything at once. Industries are not created in a day. We should profit by the experience of other countries which have grown industrially great, and, in the pursuit of the Swadeshi ideal, we should follow the methods which have proved successful in those countries. I admit that in one important respect the conditions with which we are beset are somewhat different from those prevailing in countries which have come to the front as centres of the world's great industries. We cannot look to Government to give us any direct help in the shape of protective import duties or bounties such as have been given in other countries. But, short of that, Government can do much, and I am satisfied that they are not likely to revert to the old *laissez-faire* policy in respect of our industrial advancement. Although, as I have said, we cannot do everything at once, our plan of action should be drawn up with a view to future developments in all directions. When you view the industrial situation, Gentleman, the first thing that forces itself on your attention is the primitive condition of the premier industry of the country—I mean the agricultural industry—the industry which supports more than 65 per cent. and, according to Lord Curzon, 80 per cent. of our population, and on which we must depend for our subsistence as well as for the raw material of our chief manufacturing industries. So long as agriculture is carried on in the present primitive fashion, no great industrial improvement need be expected in India. Even Protectionist Economists admit that until the agricultural industry has reached a high state

of development, manufacturing industries cannot be largely brought into existence even with the support of the State. In England itself the era of manufactures was immediately preceded by a period of extraordinary agricultural development, due mainly to the enterprise of the great landlords. I rejoice to see that the greatest landlord of all in India, namely, Government, are recognising their duty and have taken and are taking measures to spread a scientific knowledge of agriculture by means of colleges, experimental farms, and such other measures, to free cultivation from insect pests, and to introduce new and valuable forms of the agricultural industry. The work done in connection with rubber cultivation, if it lead to the tree becoming naturalised in India, would add materially to the national income, as the demand for rubber all over the world is immense. While Government are waking up to their duty, it behoves private landlords, like the Zemindars of Bengal, who correspond to the landed aristocracy of England, to devote their time and resources towards developing their industry. Gentlemen, if the Swadeshi spirit inspires these great landed magnates to introduce science and system into agriculture so as to make it yield the highest profit of which it is capable, then, believe me, you will be in sight of large manufactures, financed, controlled, and worked by our own countrymen. It is a common fallacy to suppose that the arena of great achievements lies far afield of our everyday lives. It is never so. Few people talk of the Swadeshi movement in connection with agriculture. But really that is the industry which most requires the application of the true Swadeshi spirit, for on it are based all our possibilities of manufacturing industries. If the mill industry flourishes in Western India, it is because the Guzerathi is acknowledged on all hands to be the most efficient cultivator of cotton in India.

#### MINERAL INDUSTRY.

From agriculture, let us turn to mineral industries, in which considerable interest is being evinced at the present

time. I do not think that there is any one in India who can speak with greater authority or give more valuable information on this subject than Mr. Holland, the Director of the Geological Survey of India, and I would remind you of his admirable paper read before the Conference last year as well as to his official reports. He is a gentleman with the true Swadeshi instinct in him, and I believe that to his writings and his influence is due to a very large extent the active interest shown everywhere in mining enterprise. Possessed of the knack of clothing technical matter in popular style, his reports are easily intelligible to the general reader and have been read everywhere with enthusiasm. There was a very marked development of interest in mineral industries last year, resulting in an increase of 50 per cent. in the prospecting licenses and mining leases taken up. The explorations of geologists confirm the verdict of ancient history that our country is rich in minerals of every kind, and that there is hardly anything which we cannot produce if only capital, enterprise, and the requisite technical knowledge were forthcoming. The total value of the mineral productions of India, omitting minor industries for which no returns are available, was over  $8\frac{1}{2}$  crores of rupees in 1905. Gold and coal contributed two-thirds of this value, and in both of these mineral industries I need hardly tell you that Indians have very little share. The same is the case with the petroleum industry, which comes third in the list of values. These three together account for three-fourths of the total value of mineral production in India. What are the causes of this apathy on the part of the Indian people? Want of capital is one cause. But want of technical and scientific knowledge is probably a more important one. One of the first needs of the country, therefore, is to educate a large number of young men and to train them up in mineral industries. So long as there is the present dearth of skilled experts, and one has to pay a high price for the preliminary work of

exploration, we can never expect mining industries to progress rapidly. One does not grudge to pay a high fee to an expert who has to be consulted at the final stages or from time to time during the progress of the work of exploration. But for preliminary work, we want a large number of trained men with a thorough practical knowledge of the different kinds of mineral industries. Government have already done something in this direction. In Bengal a scheme for giving mining instruction has been sanctioned by the Imperial Government, and a Mining Professor and a Mining Inspector have been engaged. The experience of these officers has dispelled the fear expressed in some quarters that there was no real demand for mining instruction in India. Professor Robertson has received applications which show that India-trained mining students will be able to readily obtain employment when they become qualified. Four young Indians are studying mining in the University of Birmingham, receiving Government scholarships of £150 per annum. These are happy signs, but we cannot help thinking that instead of sending Indian students to learn mining in England, the conditions here are such that Government, by establishing an up-to-date Mining College in India, can make this country a great centre of mining instruction, besides training our own students to take charge of the higher posts in the Geological Department. If it be deemed necessary to give Indian students the expanded knowledge that comes of visiting the centres of mining in Europe and America, it can be so arranged that after completing their course of studies in the Indian College, they may spend a short time in those centres. It is a matter for thankfulness that Government rules in relation to mining enterprise are liberal and, speaking from my own personal experience, I can say that the Geological Department is always anxious to give the fullest information and assistance to any enquiry. In connection with the mineral industries it has been pointed out that without a cycle of chemical indus-

tries, it is almost impossible to make several of them paying. Several instances of this kind are mentioned in Mr. Holland's quinquennial review published last year. In his paper read before this Conference last year, Mr. Holland referred to the manufacture of ammonium sulphate as a very promising industry. It is gratifying that the East Indian Railway Company has now nearly completed the erection of a plant on the Giridih coal-field for this purpose. I have no doubt that other colliery owners will follow suit when they find that this experiment proves successful. I also understand that a small plant for the manufacture of ammonium sulphate from gas-liquor has been set up by the Calcutta Gas Company, using sulphuric acid. There is a vast field for this as well as for similar industries which make use of the bye-products of mineral industries, but a large number of chemical experts are required to utilise them in full measure.

#### COTTON INDUSTRY.

I will now refer shortly to manufacturing industries, of which cotton is by far the most important, both in bulk and value. Next to food comes clothing among the necessaries of life. I will not detain you with the statistics of the industry. These have been ably enlarged upon in some of the papers read before the Conference at Benares. Nor shall I take up your time with my opinions on the hand-loom industry and its prospects. A separate Resolution is to be submitted to you on the subject, and the speakers to that Resolution will not thank me for anticipating their remarks in my address. The importance of the hand-loom industry is widely recognised, and the only question is how the ordinary hand-loom can be improved so as to meet the competition of its rivals. The conditions of the new hand-loom are that it should be cheap, simple in construction, and capable of being easily repaired by the village carpenter, while at the same time the output should be larger than that of the existing ones. There are several inventions in the

field, and only experience can show which of them come up most to these requirements.

Turning to the power-loom industry, of which I can speak from personal knowledge, most of you are aware that Indian mills produce cloth generally of the coarser kinds, largely manufactured up to 21s warp and 30s weft, and only a small proportion of finer kinds of cloth. The reason why they have to restrict themselves to the production of the coarser sorts, is the quality of cotton grown in the country at present. So long as cotton of superior staple is not produced here, it is hopeless to expect the manufacturer to improve the quality of his cloth. That he is doing his best is clear from the fact that the official returns show that every year finer qualities of cloth are manufactured to an increasing extent. At the present moment cloth of the quality which Indian mills largely produce is hardly imported into India. If the country gives the Indian manufacturer a superior staple cotton, there can hardly be a doubt that he will be able to supply the needs of the people from his looms. What a large field there is yet to be exploited by the Indian power-loom weaver, is shown by the fact that the quantity of cloth imported from Great Britain last year amounted to over 200 crores of yards. Besides we imported  $3\frac{1}{2}$  crores lbs. of yarn. If the Indian mill-owner is able to produce the superior kinds of cloth and yarn, he can safely increase the number of mills to ten times what they are. I am glad to say that the prospects of our being able to weave finer cloth are fairly promising. The gratitude of the country is due to the Government of Bombay for its action in regard to the experiments for the cultivation of high-class cotton in Sind from Egyptian seed, which have been attended with splendid success. The area sown this year was 7,000 acres; from the point of view of the agriculturist also, the introduction of the superior cotton has been a great boon. The yield per acre was greater and the price considerably higher than that

obtained for ordinary Sind cotton. The gain to the cultivator is so great from the introduction of Egyptian cotton, that it is not extravagant to hope that all the arable land suitable for this quality of cotton on the banks of the great perennial irrigation canals, which is estimated to be at least 100,000 acres and is probably more, will be brought under it at no distant date. The only retarding feature is that this year the plants were attacked by Boll-worm and sustained damage to the extent of 50 per cent. But the Government Entomologist, Mr. Lefroy, has suggested to cultivators a certain method of prevention which we may hope they will follow. When this comes to pass, the conditions of the Indian cotton industry will be revolutionised, and India will be able to supply a very large portion of her demand for superior kinds of cloth. Then will be the time for the full realisation of the Swadeshi ideal in respect of our clothing. Until then for superior varieties of cloth we must depend on the foreign producer.

May I venture to make an observation here in regard to the complaint lodged against Indian manufacturers by our Bengali friends to the effect that they (the manufacturers) did not sufficiently support them in their patriotic and unselfish Swadeshi propagandism? Those who brought forward the charge did not realise that prices are regulated by the unalterable laws of supply and demand, and that, howsoever laudable the object may be, it is impossible to control prices by artificial means, even if the manufacturers desired to do so. The manufacturer is only one stage in the process whereby the cloth that he produces reaches the person who uses it. Between him and the consumer there is a hierarchy of intermediaries, all of whom, depending as they do on the profits of trade for their maintenance, are not likely at any time to forego the opportunity of higher profits. Even if the manufacturer reduced prices to a slight degree below the market level, it would not at all follow that the consumer would get the advantage. The dealers would get it.

The mechanism of trade is a highly complex one, and a single bale of cloth has to pass through three or four hands before it reaches the consumer. It is too much to expect each of these persons to be so philanthropic as to lose his legitimate opportunity. The complaint is founded on a misconception as to the nature of trade which follows high prices as water flows from a higher to a lower level.

The one unfortunate element of the Indian cotton mill industry is that it has always been looked upon by Lancashire manufacturers with unfriendly eyes. From time to time, the self-interest of these manufacturers has laid a heavy hand on our long struggling industry under one pretext or another. Now, it is the sacred principle of free trade; at another time it is humanity and philanthropy and all the virtues of mankind rolled into one. I do not refer to the abolition of the import duties on cotton goods twenty-five years ago. But the imposition of the excise duty on mill-made cotton cloth in compensating for a revenue duty on imported cotton goods was a flagrant departure from the practice of Great Britain itself. But this has not been enough. The cry is now for restricting the hours of labour of adult male labourers in our mills. The reason assigned for the interference is, of course, humanity, but sometimes the cloak is thrown aside and the naked truth comes into view. Thus during the discussion of the Indian Budget in the House of Commons, Mr. Keir Hardie complained that the manufacturer in India had the advantage over the manufacturer in Great Britain of lower wages. It was wrong, he said, that he should also have the advantage of long hours. Well, if we consider what immense advantages England has over India in regard to manufacturing industries, on the principle of Mr. Keir Hardie's complaint, we should be justified in asking for a curtailment of many of them. But who would listen to us? If the possession of cheap labour is an undue advantage, why not the possession of cheap capital? The fact, however,



is Lancashire does not care to argue with us. It is the old story of the wolf and the lamb. Lancashire would be glad to kill the Indian industry, and one reason is as good as another for that purpose. It is due, however, to the Government of India to acknowledge that they have always tried to withstand the pressure of Lancashire, though, unfortunately for us, often without success. Now, Mr. Morley has been induced to send out a special Inspector to enquire into the conditions of labour in Indian factories. The factory-owners in India will do their best to facilitate his work, for they have nothing to conceal. But we have our fears that Lancashire will be satisfied with nothing less than putting a limit on the hours of adult male labour. Such a thing would be unprecedented, and we may hope that the Government of India will energetically protect the interests of our industries. We may appeal to Mr. Morley himself, who is fully cognisant of the evils of such restriction to resist the attempts of Lancashire to cripple the Indian industry. The Bengal Chamber of Commerce has strongly protested against interference with the hours of labour in jute mills, and on behalf of the cotton mill industry, I humbly add my protest in the same sense to that of the Chamber.

#### SUGAR INDUSTRY.

I have dwelt at length on the two most important industries of India. There are numerous other industries for which there is a vast field in this country, and which, if taken up by our capitalists, would be productive of great benefit to themselves as well as to the labouring population. After cotton piece-goods, sugar is the most important article imported into India in point of value, and it is well known that the sugar industry has been declining in this country of late years as the result of foreign competition. The history of the establishment of the beet sugar industry in Europe and its development to its present proportions is one of the most fascinating chapters of industrial history, and for a succinct account of it, I would refer you to the

excellent series of articles which have appeared in the pages of the *Indian Trade Journal*, which my friend, Mr. Noel Paton, edits with quite as much zeal as ability. *The Indian Trade Journal* has enhanced the practical value of the series of articles on sugar by publishing statistics relating to the production of sugar-cane and the demand for sugar in each of the provinces of India. India is the home of the sugar-cane, and is it not strange that we should be ousted from the manufacture of sugar by foreign competition? There is an immense market for sugar in this country. What is needed here is, first, the improvement of the quality of the sugar-cane grown and the introduction of modern machinery. Investigation has shown that beet-root cannot be grown in India on a profitable scale. But it has been found possible to increase the percentage of sugar in the cane by the use of suitable manure. Thus the problem is an agricultural one first. The United Provinces of Agra and Oudh have the largest area of land under sugar-cane, and we may hope that our friends in those provinces will take early steps to organise the sugar industry on modern lines.

#### OTHER INDUSTRIES.

There are similarly the jute industry which our Bengali friends ought to develop; silk, which may be introduced in several parts of the country, and paper in Burma, as shown by an instructive monograph just issued by the Government paper expert, Mr. Sindall. Leather is another industry for which there is a large field in India. It does not require large fixed capital, and, in spite of the prejudice against working in hides, there is a large amount of cheap labour available. The enormous number of hides and skins exported from the country every year shows that there is no lack of the raw material for the industry. We are thankful to the Government of Madras for all that it has done and is doing to establish the Chrome Leather Industry in that province. I would observe in passing that it is not necessary nor is it

advantageous that the same industries should be established in all parts of the country. This may not be possible in the first place. Even where it may be possible, it may be found, perhaps, that the production of wealth will be better assisted by leaving provinces to promote the industry for which they have special facilities.

#### INDUSTRIAL SURVEY.

I venture to suggest that the Commercial Department should have its counterpart in each province, the duty of the provincial department being to devote its attention to the industrial and commercial possibilities of the province and keep in touch with its economic problems. Of course this is being done to some extent under the present system, but the work deserves to be attended to more systematically and thoroughly. I read with pleasure the other day in the papers that the Madras Government has appointed Mr. Alfred Chatterton, Director of Industrial and Technical Inquiries in that Presidency for five years. Mr. Chatterton's work for the industrial development of the Southern Presidency is well known, and there is every reason to expect that in the next five years he will be able to do important service in exploring the industrial capacities of the province. We want similar measures in every province in the country. Provincial agencies will be better able to conduct the much-needed survey of indigenous industries recommended by the Committee on Industrial Education appointed by Lord Curzon, and also suggested by the Hon'ble Mr. Hewett in his last Budget speech. He urged the Provincial Governments "to make a survey of the state of indigenous industries within the area of their jurisdiction with a view to ascertaining the exact state of the various industries and handicrafts, the amount of the earnings and the present condition of the artisans respectively employed in them, the precise manner in which the different industries have been affected by competition with imported articles, the practicability of creating new markets or of developing markets which already

exist, and the possibility of giving a new lease of life to these industries, either by means of special instruction or by the improvement of the appliances in use”.

#### LABOUR QUESTION.

Gentlemen, I have spoken of the organization of capital, and the development of industries. I should not omit to make a few observations on the all-important question of the supply of labour. True, we have a large population, but owing to illiteracy and the prejudices concomitant to it, every industry in the land feels the difficulty arising from not having an adequate supply of labour. In order to convert our vast population into an effective labour-force, we have first of all to instil into them the rudiments of knowledge, which will widen their mental outlook, fill them with new aspirations and enable them to know what opportunities await them in the industrial world, and to take advantage of them for their own and their country's benefit. Plague has in many parts of the country played sad havoc with the labour supply and, speaking from the purely industrial and commercial point of view, I beg to express the earnest hope that Government may be pleased to create more centres of investigation, so that the discovery of a remedy may be accelerated.

Except by the Committee working at the Parel Laboratory, which is doing excellent work, there is no effort made at present to elucidate the etiology of the disease, and what can one Committee sitting in a single centre of plague do to trace the causes of a calamity so widespread and elusive?

#### EDUCATION.

Gentlemen, you all know that the Government of India have addressed Local Governments on the subject of the abolition of fees in primary schools throughout the country. From the strong views expressed by the Supreme Government in their circular letter, we are led to hope that the proposal will be carried through at no distant date. This

will be the first step towards introducing a system of universal national education, and its effects are bound to be most beneficial to the people. Gentlemen, I hope that Government will be equally liberal towards technical education, for which the grant now made is insignificant, considering the vast extent of the country and our large population. What I have said above as to the necessity of a large number of experts for the development of mining industries applies with equal force to all industries, and hence technical education on a large scale is one of our primary needs. I may also mention here the importance of a wider spread of commercial education, which at present is practically neglected by the State. I ought to make an exception in the case of Bengal, where commercial education is imparted in the Presidency College at Calcutta, and Madras, where a rather feeble attempt has been made to encourage it. Those who do not understand what commercial education is, and mistake it to be mere book-keeping, sneer at it; but commercial education is much more than that, and if there were more of commercially educated men among us, we would be able to retain in the country a very large proportion of the profits which now go to foreign firms which do importing and exporting business only.

Coming to the highest departments of industrial education, the department of scientific research, it is gratifying to note that, after a long period of suspended animation, the Indian Institute of Science, which owes its origin to the far-seeing patriotism and princely munificence of the late Mr. Jamsetji N. Tata, is likely to shortly become an accomplished fact, as evidenced by the appointment of Dr. Travers, an eminent scientist, to the Directorship of the Institution. All these are hopeful signs of the times, and I am sure you will agree that they all point to a bright industrial future for our country.

#### CONCLUDING REMARKS.

Gentlemen, I have endeavoured in the remarks that I have made to-day to set before you in as few words as

possible the main features of the industrial situation as it appears to me—the importance of utilizing foreign capital in the development of the country instead of being utilized by it for its own gain, the principal directions in which industrial progress may be made, the lines on which we should proceed, and the requirements of the country in the matter of technical and scientific education. No doubt there have been omissions, but these, I am sure, will be supplied by the gentlemen who will speak on the several resolutions to be placed before you. The word ‘Swadeshi’, Gentlemen, signifies the love of motherland. It does not signify hatred of any other land. This love of motherland, if it really becomes a part of our nature, will manifest itself not in one direction only but in all; not in one department of life only but in all departments of it. Industrially you all know that Swadeshimism is enforced in many civilized countries by means of prohibitive tariffs, and bounties to home producers. This may or may not be a wise policy, but there is at any rate nothing immoral or unrighteous. We are only following the example of these nations, and following it at a very great distance, by making voluntary efforts to encourage indigenous industries. There is nothing wrong in this. On the contrary, it is all the more creditable to us that what in other countries requires to be enforced by the State, is undertaken here by the spontaneous action of the people. May the spirit of Swadeshimism grow among us, and may the development of industries, which is sure to follow it, lead to the permanent prosperity of this, our Motherland.

## MR. P. N. BOSE'S WELCOME ADDRESS.

MAHARAJAS, LADIES AND GENTLEMEN,—I deeply appreciate the honour which the Bengal Committee have done me by appointing me their President, and, as such, I have much pleasure in welcoming the delegates and visitors from different parts of India. I must frankly confess my welcome is a trifle tinged with selfishness. In the matter of industrial enterprise, we have more to learn from our guests than they from us. We shall have to subject them to a process which is expressively (though vulgarly) called "pumping"; and if we are mindful of our interests, we should "pump" them dry before they leave us. We have met to attempt the solution of a problem the most important that can engage the attention of our countrymen at the present day. It is a very complicated problem, the most complicated of all the problems with which we are at present confronted. But there is one salient feature which distinguishes it from good many of the other problems: however difficult it may be, it is one which, if we are determined, we can solve ourselves with the help of the Government if it be forthcoming—and the present attitude of the Government encourages the hope that it will be forthcoming—or even without such help if it be not forthcoming, at least to the extent desired by us. Our brethren in other parts of India, and notably in the Bombay Presidency, have already made some advance towards the solution. The numerous, flourishing, gigantic cotton mills of Bombay and Ahmedabad may well serve as so many object-lessons to us. They are mostly owned, managed and officered by Indians. I have of late made several trips to the Western Presidency, and last October penetrated into the heart of Kathiawar. Wherever I went I noticed enterprise and industrial activity—not yet, it is true, to an extent desirable for a complete solution of the industrial problem, but certainly to an extent incomparably greater than what we have hitherto met with in Bengal. I say hitherto, because now my Bengali friends are beginning to attack the problem with a vigour and an earnestness which promises great results in the future. There is, however, still observable in them a special predilection for petty industries, which partake more or less of the nature of handicrafts and stand in a little need of labour-saving machinery—industries which can be started with a small capital and therefore hardly require any co-operation. There can be no question that such industries are useful in their way, and that the possibilities of such industries should be developed to the

fullest extent goes without saying. But we must bear in mind that they will not go very far towards meeting the exigencies of our situation. In an address which I had the honour to deliver as President of an Industrial Conference held in this city in 1891, I said: "The good old times have passed away. We may sigh for them, but they will never return. We must move with the times or perish. The progress of natural science has effected a revolution in industrial methods. The day of mere manual skill is gone by, and, rest assured, will never return". I regret to have to repeat and even emphasise these words after the lapse of fifteen years. Those of my friends who are so sanguine as to expect to dislodge Western manufactures from strong positions held by them in our markets with such weapons alone as the primitive furnace, the "charka" and the hand-loom, however improved, would do well to visit the great mills and factories of Northern and Western India, or, failing that, to extract as much wisdom as they can from our visitors.

Some of my compatriots of Bengal are probably regretting having made me their spokesman. So I hasten to say that though our province has hitherto evinced a deplorable dearth of commercial and industrial enterprise, she has excelled in other spheres of activity. We have in this city as many as five daily newspapers, conducted entirely in English, and owned, managed and edited by Bengalis; but, so far as I am aware, my compatriots of Bombay cannot boast of even one! This, however, is a form of activity which may be considered by some to be hardly deserving of commendation under existing conditions. The gentlemen of the press must not misunderstand me. I have not been a public man; and I do not know whether I am pachydermatous enough to survive a shower of their sharpest missiles. What I mean to say is, that indigenous journalistic activity of the sort we have in Bengal (while there has hitherto been no very marked display of activity in spheres where it is more urgently needed) may be held by some to be a point of questionable superiority on our part. But there are other achievements to which no such exception can be reasonably taken. I doubt if all the other provinces put together could produce such an illustrious array of social and religious reformers, authors, legal luminaries, and last, but by no means the least, orators, than that turned out by Bengal during the British rule. Several of the most important movements



of modern India have had their origin here. The latest of these — the Swadeshi movement—did not originate in Bengal. But Bengal has given it an impetus which I doubt if it could have got elsewhere. The development which it has recently attained has been an agreeable surprise to me. In a magazine article entitled "A Plea for a Patriotic Movement", published in May 1903, I wrote as follows:—

"A movement has been going on for some time past in different parts of India which is known as the Swadeshi (or patriotic) movement. Its object being protection of indigenous industries, it is not much favoured by the generality of the more highly educated Indians, who are imbued with the doctrine of Free Trade imparted with English education. When they, however, awaken to a sense of the fallacious nature of that doctrine, when applied irrespective of surrounding circumstances, as I have no doubt they will soon, they will not only cease to look askance at this hitherto obscure and little recognised movement, but will perceive in it the germ of a great organisation which, if well directed, may effect the industrial regeneration of India. A great central organisation with branches in all important towns, having for its object the promotion of the interests of indigenous manufactures, will go a long way towards at least a partial solution of the complicated problem of Indian industrial development . . . . . The idea of such an organisation may at present appear to many as chimerical. But there is really no reason why it should not be realised if a few earnest, capable, self-sacrificing men make it the mission of their lives. What is needed is a clear conception of its urgent necessity, and a firm conviction that, without the fostering care and watchful vigilance of some such organisation, the infant enterprise of Young India will be unsuccessful and infructuous".

Little did I dream at the time I penned these lines that within two years the movement for which I pleaded with such diffidence was to become so popular. Though no indication of any proper organisation is as yet perceptible in it, there cannot be a shadow of a doubt that it has made for progress. Here, again, our strong and weak points have manifested themselves. While we, Bengalis, have been writing, talking and agitating, our more practical brethren of the other provinces have been quietly filling their pockets. I was conversing with a big Parsi

merchant in Bombay last February, when he observed in connection with the only conspicuous tangible result of the Swadeshi movement at the time in Bengal, a result over which our newspapers were most jubilant—the Banga Lakshmi Cotton Mill : “ Why do you not start a new cotton mill on a large scale ? The one you are going to acquire is an Indian concern already, why not have another ” ?

I hope our guests will be as frank in their criticism as this Parsi gentleman. We must not be impatient of honest criticism, but should rather welcome it if we really mean to improve.

I must accord a special welcome to those of our Western friends who are extending a helping hand to us. We are very grateful to them. We expect a deal of light from them. They are so far ahead of us in respect of industrial development, that for many years to come we shall have much to learn from them. We should not be under any delusion. There is no sign yet of the approach of the millennium. Human nature in the civilised world is much the same now as it was two or three thousand years ago. A clear recognition of this truth, which I must say is generally occluded by the glamour of occidental civilisation, would save us a deal of unnecessary expenditure of time and energy. This, however, by the way. The industrial interests of the West are not generally identical with those of the East : nay, in not a few cases they are altogether antagonistic. The day is not far distant when there will be a great industrial war between the Orientals and the Occidentals. The war is inevitable, and our brethren of the West must be well aware of it. Constituted as human nature still is, we cannot expect that they should all place in our hands weapons which they know would some time or other be directed against them. But the fact that we have some sincere, earnest friends among them who, rising superior to circumstance, not only sympathise with us, but are also ready to work hand in hand with us, shows that chivalry has survived the deadening influence of the most material of civilisations the world has ever seen. All honour to those chivalrous, benevolent gentlemen. They are the salt of the earth.

Two years ago I had the good fortune of camping with an illustrious American expert. I used to have many pleasant and informing conversations with him. One day our conversation turned upon the phenomenal industrial development of the West.

I asked him what its goal was. My friend—the practical man that he was—said he did not know what the goal was; all that he knew was that the wheels must go on crushing whom it may. But, Gentlemen, while he knew this, he was at the same time ready to advise us as to how we might arrest the progress of the wheels of Western Industrialism and avoid being crushed. The knowledge that we have such friends in the West—especially in Great Britain and America—buoy us up with hope for the future.

Here I would like, with your leave, to set right a matter about which there has been some misunderstanding. Our Anglo-Indian friends generally profess sympathy with the Swadeshi movement. An English gentleman proposed to me the name of Swadeshi for a company he wanted to float in order to attract Indian capital. But volleys of indiscriminate abuse are occasionally directed against the leaders of the Swadeshi movement. The last notable instance of such a fusillade was at an important annual function in this city. That there have been some indiscretions, some excesses, is undeniable. But they are mostly peccadilloes of nonage, and are unavoidable in a movement which becomes at all popular. Mr. Morley in his last India Budget speech said: "Great thoughts come from the heart, but must go round by the head". This should, no doubt, be the case with the wise men of the world, but the pity of it is, there are so few of them! With the mass of the people thoughts seldom take the circuitous route prescribed by philosophers, but go direct out of the heart. As a consequence all movements taken up by them—social, religious or political—have always been characterised by features such as we would expect when passions and emotions are but little controlled by reason. But would you rather wish that great ideas lay confined within a small circle of wise men, than that they should spread among the masses and elevate them, although in so doing they lose their original purity? The water which is imprisoned in the clouds up above is pure. But would you rather that it lay there than that it should descend to the earth and fructify it and afford drinking water to its thirsty millions, although in descending to it and while there it absorbs various impurities, sometimes to the extent which renders it positively noxious?

Gentlemen, my next very agreeable function is to ask H. H. the Maharaja Gaekwar of Baroda to deliver his inaugural

address. I feel the greatest pleasure in doing this, not because he happens to be a ruling Chief of the first rank—no—but because, though a great Prince, I know of no one else in this assembly who is better entitled to speak authoritatively on subjects to be dealt with by this Conference. In His Highness' case, it may be truly said, that it is the man that honours the rank and sheds lustre on the crown. In him we have the rare combination of a gifted and benevolent ruler, a true patriot, and an ardent though cautious reformer. As long ago as 1890, His Highness established the Technical Institute of Baroda, an institution the utility of which is so highly appreciated that it attracts students even from the distant Central and United Provinces—an institution the like of which, be it said to our shame, we have not had in this province until only six months ago, when the Bengal Technical Institute was founded, thanks to the liberality of some of my large-hearted compatriots, foremost among whom is my esteemed friend, Mr. T. Palit. Now, the State of Baroda has a population in round numbers of two millions. I find there are as many as thirteen districts in Bengal, each of which contains more, and several considerably more, than that population, and three districts, each of which has a population only slightly less. Imagine, Gentlemen, each of these sixteen districts possessing a technical institute of the same type as that of Baroda, but adapted, of course, to local conditions. Why, the economic and social condition of Bengal would then be quite different from what it is now.

Gentlemen, technical education has been very sadly neglected. Our Government must have long been fully aware of the gradually increasing importance of such education, and its urgency has been repeatedly pressed upon their attention during the last 20 years. But the machinery of the Government moves very slowly, and when it does move, it does not always move in a way which commends itself to our amiable judgment. As long ago as 1886 a scheme was suggested by which the Sibpur Engineering College could be made to impart superior technical training in various subjects at but comparatively small additional cost. But it is only since the beginning of this year that a serious attempt has been made by the Government in that direction. Provision has now been made for the teaching of mining in Bengal—half a century after the starting of coal mining in that

Province! During the last two decades voluminous reports on industrial matters have been turned out by the Government Press—reports which would fill a small library and which are replete with the most useful information. But our people have not had the necessary training to turn it to account. It is our Occidental friends who have benefited most by the researches of those departments of our Government which are directly or indirectly connected with the development of the resources of our country. A Commission appointed by the Government of India in 1902 reported upon the condition of industrial education in India the next year and made some excellent recommendations. I am not aware, however, that the Government has yet done anything to speak of to carry out those recommendations. In fact, the history of the progress of technical education in India during the last twenty years is practically a blank.

I rejoice to say, however, that steps have of late been taken which promise good results in the future. But, Gentlemen, we must be just and impartial. I do not think it would be fair to cast all the blame upon the shoulders of the Government. We are to blame also,—I should say, blame even more than the Government. Situated as we are and under the existing conditions of the ethical development of the civilised world, it would not be reasonable on our part to expect much from our Government. After all, one must work out his own salvation himself. The very attempt to do that, if it be earnest and insistent, will call forth and develop qualities which must ensure ultimate success. Our Government is not in the happy position of a talented, benevolent autocrat like H. H. the Maharaja Gaekwar, who has not only inaugurated an effective system of technical instruction, but has also initiated—and very wisely initiated—industries for the fructification of such instruction. As long ago as 1883-84, His Highness established a cotton mill, and now there are no less than three large weaving and spinning mills in his State, all of them organised and managed by private indigenous agency. His Highness has also pioneered the sugar industry in his State. Already the impetus given by him to industrial development has resulted in the starting of numerous ginning presses, and of dyeing, chocolate, rice, rectified spirit, and match factories; and the Baroda State promises to be a great industrial centre in the near future. But, for various reasons, it would not be desira-

ble for a Government like ours to engage in commercial undertakings. All that we can rationally expect of them is the dissemination of technical education. Even then it would be hardly wise, as we have learnt from the experience of the last twenty years, to depend upon them entirely or even mainly. The technical education, however, is of no use—absolutely no use—unless we have industries to utilise it. Technical training and industrial enterprise must go hand in hand. But, Gentlemen, we have hitherto shown a most lamentable lack of such enterprise, except, be it noted to their credit, by our brethren of the Bombay Presidency in the matter of cotton manufactures. Hitherto our economic resources have been exploited mainly, and in the case of minerals almost exclusively, by Western enterprise. Within the 24 years (1881-82 to 1904-05) the number of jute mills has nearly trebled (8 to 22); that of mills for wool, silk, and hemp has increased more than ten times (3 to 31); that of paper mills has increased five-fold (1 to 5); and that of sugar factories has more than doubled (4 to 9). Within the ten years (1894 to 1903), the output of manganese ore increased about 15 times (11,410 to 165,006 tons); that of petroleum more than seven-fold (11,452,649 to 87,859,069 gallons); that of mica nearly quadrupled (285 to 1,077 tons); that of gold nearly trebled (210,412 to 603,218 ounces); and that of coal more than doubled (2,823,907 to 7,438,386 tons.) But, alas! indigenous enterprise has had very little share in this industrial expansion.

I am fully aware of the formidable obstacles which confront us. We are handicapped by our excessive poverty, by our sad deficiency in scientific and technical education, by our social system, by our civilization, which is of an essentially non-industrial character, and by the absence of that State protection which infant enterprise in all countries stands in need of. But at the same time I see no reason why an intelligently directed, well organised and persistent effort to overcome the difficulties in our way should not be crowned with success.

It seems as if such an effort is going to be made now. There are hopeful signs of an industrial awakening on all sides. This Conference and the Exhibition across the way are among such signs. They show that the industrial movement which has been going on slowly for the last quarter of a century has at last been taken up by that great body of my

educated and patriotic countrymen who constitute the Congress. I humbly beg leave, however, to say one word by way of caution to my Congress friends. The machinery and the method of work adopted by them for the Congress will not quite answer the purpose of this Conference. This platform affords us an excellent opportunity for the discussion of important industrial subjects and for an interchange of ideas. But the more important part of our work will have to be done silently and strenuously in the study, the laboratory, the field, the workshop, and the factory. The subjects dealt with by the National Congress are mainly of a nature which precludes the possibility of strong fruitful action, year in and year out, therefore they have had to content themselves for the last twenty years with advocating reforms and recommending measures the execution of which depends upon a will which is not their own. The Industrial Congress, however, presents to us a very wide field for action, calculated to lead to momentous results in the immediate future; and we need not, and in my humble opinion should not, urge a single measure which we are not prepared to carry out gradually ourselves, either independently or with the help of the Government.

This very assembly is an indication of the industrial awakening of India—and a very significant indication too. It is, I believe, the first of the kind in India. For the first time in our history two ruling Princes have got over the barriers interposed by immemorial custom, and have condescended not only to grace this meeting by their presence, but also to take an active part in its proceedings. I see around me representatives of the landed, legal and mercantile aristocracy, owners of such capital as we have in this country; I see around me representatives of the different sections of our middle class who are to supply us with workers; and I see around me high officials of the Government who have it in their power to help us in a variety of ways. If they cordially join hands, and work shoulder to shoulder, we shall not be long in solving the difficult problem we have taken in hand. Verily, there is some hope for a cause which has brought together such a distinguished and such a representative gathering; and there is some hope for a Conference which is to be opened by such an enlightened and such an accomplished Prince as H. H. the Maharaja Gaekwar of Baroda.

# THE FIRST INDUSTRIAL CONFERENCE AND A YEAR'S OUTTURN OF WORK.

MR. R. C. DUTT, C. I. E.

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MR. PEESIDENT, LADIES AND GENTLEMEN,—It is my pleasant duty to lay before you the report of the first Industrial Conference, held last year at Benares. Along with it I wish to place before you a report of the work of the Conference during the year which is about to close. And, lastly, I ask your permission to present you also with a very useful Directory of Indian industries and Indian goods which has been published by the Conference office.

The first Industrial Conference was held in December, 1905; and, as you are all aware, the first year is a critical year in the life of all institutions. The rate of infant mortality is, I am afraid, very high among our Indian institutions; but you will be glad to learn, our institution shows every sign of a strong healthy and useful life. I ask you all Ladies and Gentlemen, to join your good wishes with mine for the well-being of this promising and hopeful child, whom I made over the other day to the fostering care of our new president, the Hon'ble Vithaldas Thackersey.

Our object at the first Industrial Conference was threefold. In the first place we wished to collect a body of expert opinions on the different industries of India in a series of papers which would be useful to all of us for reference and for guidance. Our second object was to make our institution not merely a deliberative body—discussing industrial questions during one day in the year—but a working body, doing some useful work all through the year. And our third and last object was, not to try and do this work all over the vast continent of India from one Central office, but to create Provincial Committees in all the large provinces, to promote, organise, and supervise industrial enterprises and to compile necessary information.

In fulfilment of our first object, we invited gentlemen who had devoted their time and attention to the study of special subjects to favour us with their views and opinions, and our invitation met with a most cordial response. The series of papers

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which you will find in this report are written by some of the ablest men in India, Government servants and private gentlemen; and I know of no other handy and popular work published in India which contains within the same limits such valuable and practical suggestions relating to agriculture and agricultural bank, mining and minerals, cotton cultivation and handlooms, industrial education and Indian industries. To mention a few among the papers, you will find in this volume a most valuable one on the cotton industry by the Hon'ble Vithaldas Thackersey of Bombay, who so worthily fills the chair, and you will find another on cotton cultivation by Raja Peari Mohan Mukerji of Bengal. You will find interesting papers on Co-operative Credit by Mr. Hope Simpson and Sir Frederic Lely, and papers on minerals by Mr. Holland and Rao Bahadur Joshi. The late Dewan of Travancore ably explains the necessity of a College of Technology in India; Mr. N. G. Mukerji writes on Sericulture; and Mr. Havell and Mr. Chatterton, who have done so much for promoting our Indian industries, write on handlooms, on chrome leather, on aluminium, and on other industries. To these, and to all other gentlemen who contributed papers to the first Indian Conference, I take this opportunity of conveying once more the cordial thanks of the Conference; and I believe their collective work will be a most useful guide to us in our labours for many years to come.

Our second subject was to make arrangements for carrying on our work all through the year, instead of being satisfied with one day's deliberation. For this purpose we established a Central office, and we were fortunate in getting so energetic, so zealous, so able a worker as Rao Bahadur Mudholkar to be our Honorary Secretary. He has devoted himself to this great task, and the success which he has achieved within the period of a twelve month, in carrying out our aims and objects, is recorded in this volume. Mr. Mudholkar has been ably assisted by his Under-Secretary, Mr. Chintamani, an untiring and zealous worker, who has within this year visited the different provinces of India, helped the Provincial Committees, compiled information and done much to promote our objects. He is peculiarly fitted for this work; and I believe it is in contemplation to allow him an assistant in the coming year, so that he may have more time to help in the work which devolves on the different Provincial

Committees. I am glad to be able to add that the subscriptions we were able to raise have covered all our expenditure; and I may remark that three public-spirited men of Baroda State came to our rescue, and subscribed Rs. 500 each when we were threatened with a deficit.

Our third and last object was to organise Provincial Committees in all the large provinces of India, and you will be glad to learn that this important work has been done. The Bengal Committee is fortunate in getting Mr. S. R. Das to act as Honorary Secretary, and the Bombay Committee is equally fortunate in getting Mr. Lalubhai Samaldas to act in the same capacity. An Industrial Association, which had been founded in Madras, consented to work as the Committee of that province; Dewan Bahadur Krishnaswami Rao, of Travancore fame, is its president; and Mr. Subramani Iyer and Mr. Hanumanta Rao are its Secretaries. I have only to add that the United Provinces Committee has appointed Mr. Bhargava as Secretary, and the Punjab Committee has elected Mr. Mulkraj in the same capacity. The Provincial Committees have thus been organized, and a beginning has been made for continued and well-concerted work all through India. It is hoped that, with a greater degree of co-operation between the Central Office and the Provincial Committees, our organization will be able to show a good outturn of work in the future from year to year.

So far, gentlemen, I have dwelt on the organization and work of the Industrial Conference of the last year. But I would like to add a few words on the industrial activity which the whole country has manifested during the year now closing. And, first of all, we must all gratefully acknowledge the grant of five lakhs of rupees, which the Government of India has allotted in the current year's budget for this purpose, one-half of which, approximately, is for technical education. It is a small grant, considering the requirements of this vast country; but we acknowledge it with gratitude, as gratitude has been described as a lively sense of greater favours to come.

Our countrymen have also shewn a laudable activity. In Bengal a Technical Institute has been founded, mainly through the liberality of my friend, the talented and patriotic Mr. Palit, whose ill-health we all deplore to-day. The Association for Scientific Education, founded mainly through the exertions of

my friend, Mr. Jogendra Chandra Ghose, sent 17 students abroad in 1905, and no less than 44 students this year, for technical education. Two or three mills have also been started in Bengal, and the number of hand-loom has more than doubled within the year, bringing relief to the great weaving population of the province, and at the same time meeting the demand of home-made cloths which is increasing all over the province. I am glad to add that the Indian Stores, Limited, for which the country is indebted to the Hon'ble T. Chowdhri, is now on a sound commercial basis, and similar stores are multiplying all over the country.

Among the great captains of industry and enterprise in the Bombay province, the name of the late lamented Mr. Tata stands foremost in the hearts of his countrymen; and the Iron and Steel Company, which he tried to organise, is engaging the attention of his worthy sons. Two Indian Banks have recently been started in Bombay, one of them mainly through the exertions of our worthy president, the Hon'ble Vithaldas Thackersey; and an Insurance Company has been floated under the auspices of our veteran leader and patriot, Sir Pherozeshah Mehta. New mills have been started in Bombay, Ahmedabad, and other industrial towns in the West of India, and Indian Stores are also multiplying, one of the best of them having been lately opened by our Grand Old Man, Mr. Dadabhai Naoroji.

Madras has been busy during the year with her Industrial Exhibitions and has started dye-works, weaving factories, and candle and soap factories. And we are all interested in the future success of the Swadeshi Steam Navigation Company, which we trust will yet triumph over all its initial difficulties and prove a commercial success.

In Benares, which had the honour of being the scene of the first Industrial Conference, the silk weavers have started a Co-operative Association; and several sugar factories have been started at Cawnpur, Shahjahanpur and other places in the United Provinces. We all hope that the endeavours of the brother of the Prime Minister of Nepal to establish a glass factory near Dehra Dun will be crowned with success.

The success which has been already achieved in the Punjab in turning out glass-ware of a superior kind will be attested to by all who were at the Industrial Exhibition at Benares last year

or who have been at the splendid Calcutta Exhibition of the present year. Recently, a spinning and weaving mill has been started at Lahore, a Hand-loom Weaving Company at Jhullunder, and a Woollen Manufacturing Company at Amritsar. Indian Stores have been opened all over the province.

Lastly, the Central Provinces and Berar have been busy with their exhibitions, and a spinning and weaving mill and other industrial enterprises have been started at Akola.

These, Gentlemen, are a few of the indications of a healthy industrial activity which is visible all over India. The Industrial Conference claims no credit for this activity, for the Conference itself is one of the results of the spirit of the age. There is a movement which is growing and spreading day by day over the whole continent of India, which the nation has begun earnestly, and which the nation will not let die. The Swadeshi movement is an industrial revolution, more far-reaching in its effects than many political revolutions; and history will record in future ages how the people of India in the commencement of the twentieth century effected their own industrial salvation. Without any control over our own tariff or financial arrangements, without any effective voice over our own legislation or our administration—such as every other civilized nation on earth possesses to-day and such as we are bound to obtain in the near future—without any of these privileges which are the birth-right of nations, we have determined, simply by giving preference to our home manufactures to revive the industrial activity of this vast country, and to improve the condition of our industrial population. The call has gone forth from province to province and from village to village; and unnumbered millions are responding to the call with almost religious fervour. The womanhood of India has nobly joined in this patriotic work; and every true Indian, Hindu or Mussalman, Parsi, Jain or Christian, co-operates in this *Swadeshi* movement, and exerts himself for the industrial progress of his Fatherland. We are yet far, very far from success, but in our heart of hearts we have taken a solemn vow to work together towards this great object. And when we have passed away, our sons and grandsons will take up this holy work, and will accomplish what we have begun, giving our country her rightful, her ancient place among the industrial nations of the earth.

# THE EFFECT OF IMPORT DUTIES ON INDUSTRIAL DEVELOPMENT.

SIR GUILFORD MOLESWORTH, K. C. I. E.

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In a paper read before the Benares Industrial Conference on the "Industrial Development of India" in 1905, I drew attention to the manner in which the Industrial interests of India had been sacrificed to the English Fiscal Policy, and I advocated the adoption of a policy of moderate and carefully considered import duties to relieve the dead weight of taxation from the land and to prevent the crushing of India's industries, by unfair and unrestricted foreign competition.

I regret that more attention was not devoted to this subject by Members of the Conference, because I am convinced that unless some such policy be adopted it will be impossible to develop the vast industrial resources of India. It is difficult to exaggerate the importance of this question. I was glad to see that Mr. Dutt in his Presidential address said :—

"We will not see our country made a land of raw produce or a dumping ground for the manufactures of all nations."

The Swadeshi movement is a step in the right direction, but I fear it will prove a failure unless it is backed up by a policy of fiscal reform. It must necessarily be limited in action, confined as it will be to a comparatively small number of the educated and patriotic classes of India, but it cannot reach the masses and consequently can produce no practical results unless combined with the policy of import duty.

In my previous paper I have already alluded to the causes which have given an undue prestige to the fiscal policy prevailing in Great Britain for which the term "Free Trade" is a misnomer. I have also briefly alluded to the fact that British industrial supremacy was established under a policy of strict protection. Under that policy she developed her manufactures and had a complete monopoly of them. She had control of all the markets of the world, and became greatest capitalist nation. Alison in his "History of Europe" wrote :—

"There is perhaps no example in the annals of mankind of a nation having made such advances in industry, wealth and numbers, as Great Britain has made since the peace. In the 30 years that have elapsed since the Battle of Waterloo, during which it has enjoyed in Europe at least almost uninterrupted peace, its population has increased more than one-half, having advanced from 18,500,000 to 28,000,000. Its imports have doubled, having risen from £32,000,000 to £70,000,000, its exports have more than tripled, having swelled from £42,000,000 to £130,000,000, exclusive of Colonial produce, its shipping has doubled, having grown from 2,500,000 to 5,000,000 tons.....During the same period the agricultural industry of the country has been so far from falling short of this prodigious increase in its commercial transactions that it has signally prospered. The dependence of the nation on foreign supplies has steadily diminished until the grain annually imported had come (on an average of 5 years ending with 1835) to be no more than a 200th part in average years of the annual consumption, and the prodigy was exhibited of a rural industry in an old state, possessing a narrow and long cultivated territory, not only keeping pace with but outstripping an increase of numbers and augmentation of food required for the purpose of luxury unparalleled in any age." Alison "History of Europe" Chap. XCV. 66.

It should be noted that during this period the British trade was in a far more healthy character than at present, for at the end of this period in 1846 we had a *favourable* balance of trade amounting to £66,000,000, whereas we have now an *adverse* balance of £180,000,000. It must also be remembered that during this period there were but few railways and scarcely any steam navigation. It was only at the end of this period that the great railway mania set in.

It was about 1835 that an extraordinary era of prosperity sprang up throughout the whole civilised world tending to an enormous increase in the wealth of the world. This was due to numerous improvements in arts, sciences and inventions, as well as to improved communications by railways, steam navigation and telegraphs, which made such rapid strides during the second quarter of the 19th century. England was the great pioneer in these improvements, then came the great rush of gold from California and Australia causing an expansion of the currency of the world, a condition which is always accompanied by increased activity of trade. Foreign nations shared this prosperity as well as ourselves, but England was in a better position than any other nation to reap the advantages of this altered condition of affairs. As already stated she had the markets of the world in her hands, she had developed her coal, her iron and her textile industries under the policy of strict

protection ; and had complete monopoly of them. She not only supplied manufactures and machinery for the whole world, but as the great capitalist nation she furnished funds for every public work abroad with the understanding that plant of every description should be supplied from England. The value of her investments increased enormously with the rapid development of the countries in which they had been invested, and she has been enabled constantly to reinvest the produce of these investments, so that her wealth as a capitalist has become enormous and must now amount to many thousand millions sterling.

The English people, generally satisfied with this rush of prosperity and wealth, accepted without enquiry the persistent claims of the advocates of Free Trade for this result, and this idea has been so thoroughly engrained into the English mind that those who venture to question it have been thought to be men beyond the reach of argument, and policy of Free Trade has become a sort of fetish or religion not to be questioned.

The year 1846, in which our present Fiscal policy was adopted opened auspiciously. In January 1846 the Queen's speech assured Parliament of :—

“The prosperous state of the realm, the increased demand for labour and the general improvement that had taken place in the internal condition of the country.”

Shortly afterwards the leading bankers and merchants of the City of London thought it right to state :—

“For the information of Parliament that the commercial and manufacturing interests had been for some time in a state of great activity and prosperity.”

The month of May in the same year witnessed the passing of the Act which formed the first step in our Free Trade policy. In vain it was urged that it would throw land out of cultivation, that it would involve dangerous dependence on foreign supplies, and heavy taxation on England's industries, as well as ruinous competition. For many years England did not feel the blighting effects of Free Trade. She had a good start in the race and it would naturally take years for other nations to overtake her but the capital which she recklessly expended in purchasing abroad commodities which might have been produced at home, gradually armed other nations with funds for successful competition with her. It was not until after 20 or 25 years that the

effects of her policy began to be felt. The situation had to some extent been saved by the partial restriction of unlimited free imports in consequence of the Crimean and the American Civil War. Our agriculture being more heavily burdened than any other industry was the first to suffer and has been practically ruined, millions of acres having gone out of cultivation, lapsed into weedy pasture and large number of our manufacturing industries have been crushed out by unlimited foreign competition.

Mr. Carnegie in a speech at St. Andrew's has declared that the United States, under a policy of strict protection, has now taken the foremost place in wealth, production, and exports. Germany under a similar policy is rapidly overtaking us, and Mr. Carnegie thought that before long Russia would press us hardly, and this probably would have been the case but for her war with Japan and her internal troubles.

But what is the cause of this loss of industrial and commercial supremacy? It is simply due to our own folly in failing to foster a reciprocal trade with India and our Colonies. The British Empire has a huge area of 12, 000, 000, sq. Miles, comprising enormous, but undeveloped, wealth, whether mineral or agricultural. It has climates of every gradation from the cold to the tropical, capable of providing every variety of produce. It has population of nearly 400,000,000 and labour of every description, in many parts absurdly cheap. If it had been properly fostered it ought to have furnished a magnificent market, which would have rendered us independent of foreign trade and enabled us to have surpassed the United States in a greater measure than that in which she is now surpassing us. The undeveloped state of our Empire is a disgrace to Great Britain, we have not merely failed to foster its resources, but on the contrary we have handicapped our subjects in every way and allowed the foreigner advantages which our own subjects do not possess. The foreigner who uses our own Colonies and Dependencies as freely as our own subjects, contributes nothing to the cost of our Home Government or the army and Navy which protects his interests, if he has not a domicile in England; yet he reaps all the advantages of an English farm while he evades the heavy taxes and burdens which the British subjects have to pay. It is absurd to suppose that such an unequal competition can be maintained. After securing new



markets at great cost in blood and treasure, we foolishly allow any foreigner to reap the benefit at our expense and to our detriment. We now expend more than £100,000,000 a year in purchasing from the foreigner much which under a wise policy might have been supplied within our own Empire and in doing so the money is not only lost to our own subjects but it is mischievously employed in furnishing the foreigner with capital for successful competition with us, and while we admit the manufactures and products of foreign nations free of import duty, they close their doors to us with heavy tariffs.

The time has now arrived when we must decide whether we shall maintain our vast Empire or allow its gradual disintegration. Our Colonies have expressed a desire to enter into reciprocal relations with us on basis of preferential treatment, which would be mutually advantageous, but up to the present time their advances have been treated with contempt. Shall we foster its industries and develop its enormous resources, or shall we allow the slow process of neglect to complete the work of commercial disintegration and ruin? Shall we again neglect the plain teaching of history and repeat that gigantic folly, by which we lost our American Colonies, which with all her wealth ought to have been ours but for our short sighted policy in the criminal neglect of their interest and our own?

The incidence of taxation is one of the most difficult problems in Political Economy. It has been assumed by many of the followers of Cobden that a tariff must necessarily raise the prices of the articles taxed. To shallow thinkers the paradox of prices falling after the imposition of the import duty is incomprehensible, but to those who have carefully studied the matter, it is evident that there are other factors in the problem which may act *indirectly* in counteracting the *direct* tendency of the tax. No doubt in some case the imposition of a tariff does increase the price, but experience proves, as will be shown hereafter, that in the majority of cases it does not have that effect. Some times it raises the price temporarily with the result that it falls again, sometimes it has immediate effect in lowering prices by destroying a foreign monopoly or stimulating the development of a home industry, sometimes it happens that the anticipation of a tariff causes a fall of price, because the foreign producer, knowing that the tax will come

from his own profits pushes through his surplus stock at a sacrifice so as to have the tax before the tariff law can come into operation. This was especially the case before the MacKinley Act came into effect.

It may perhaps be laid down as a general axiom, subject of course to modifying influences, that when an article is or can be produced at home a tariff, if it be not prohibitive stimulates production, and does not raise the price, the tax being paid by the foreign producer, but when an article is not of home production, such as tea, coffee, cocon, tobacco, wines, etc., the tariff increase the price and the tax falls on the consumer. The practical effect of English Fiscal policy is, that we admit free of duty those articles which compete with our own industries and tax those articles which do not. We remit the tax which should be paid by the foreign producer, whilst we exact that which falls upon our own subjects.

In the year 1896 Mr. A. Williamson, being convinced that the duty, on any article which had to encounter competition of a home product fell upon the foreign producer and not upon the consumer, challenged the Cobden Club, in order to test this question, to issue a short circular to the chief exporters of Great Britain asking their experience. As the Challenge was declined, Mr. Williamson sent a circular to a large number of representative exporters of our chief manufacturing centres embracing cotton, woollen, carpet, iron and steel, brass, gold, silver, electro-plate, hardware, guns, cycles, engineering, glass, India rubber and other industries. Out of 531 replies 530 admitted that the *incidents of taxation fell upon them and not upon the consumer*. The only dissenting reply was from an American Cycle exporter, who had recently opened business in Coventry.

(A few Examples, proving that the imposition of tariff does not necessarily raise prices are given in Appendix No. 1).

In no case is the proverb "Fallacies die hard" more strongly exemplified than in the case of that mischievous and dishonest appeal to the ignorance of the masses, the electioneering cry of "Taxing the poor man's bread" In many letters discussing Mr. Chamberlain's proposals regarding the trade of the Empire, it is too often assumed that a tax on wheat must necessarily increase the cost of bread. Now this is absolutely contrary to facts and past experience.

The price of wheat is generally regulated by that which may be termed the "World's level of prices"—a level which is due to the general conditions of exchange, currency, transport and production. Tariffs in their *direct* action have but little influence on prices *unless they are almost prohibitory*. Under a well regulated system of Import Duties, there is an action tending towards the equalisation of prices in different Countries; and this is maintained by constant telegraphic communication of brokers with the principal markets of the world. A few examples will suffice. The Committee of the Belgian House of Representatives in their report of 1886 stated that, on several occasions on which Import Duties were imposed upon wheat, the price thereafter fell, and when the duty was abolished it rose except in one instance. Again in a Consular report dated 14th of May 1883, Sir E. Malet wrote:—

"Eight years' experience has shewn that the higher duties introduced in 1879 have been attended with the most successful results fiscally..... They failed to raise the price of wheat, prices had fallen instead of rising."

Again Mr. Vansittart, Consul at Wurtumburg, reported in 1818:—

"Since the addition of the duties all kinds of grain were cheaper than ever."

In 1888 the duty on wheat in Italy was raised from 1 franc per quintal to 4 francs, or about 7/6 per quarter. Practically it may be said that the price of bread remained almost unchanged, the tendency having been rather to a fall than a rise in price, although large imports of foreign wheat poured into Italy. Similar results ensued in Germany in 1892 when the duty was raised 400 per cent., and the price of wheat fell 9 per cent. Also in France in 1895 when the duty was raised, the price of bread fell 7 per cent. In all these cases it is evident the burden of taxation fell upon the foreign producer, not on the consumer. In the Colony of Victoria in 1888, under an Import Duty of 9/6 per qr., on wheat, bread was cheaper than in New South Wales which admitted wheat duty free, the reason being that the Victorian farmer was protected from an undue influx of foreign surplus, and was consequently able, not only to grow wheat with confidence but owing to the reduction of other taxation, caused by the revenue derived from foreign imports, he was in a position to grow wheat at a cheaper rate. The internal

competition was thereby stimulated to an extent which tended to a fall rather than a rise in price.

Of course if a duty be prohibitive (as was the case in which France imposed a duty of more 12/- a qr. on wheat when the outside world's price was as low as 27/-,) the price must necessarily rise in times when the home crop happens to be scanty.

The development of the tin plate industry in the United States affords a valuable example of the manner in which an industry may be developed by the policy which I have advocated. Before 1891 there was an import duty of 1 cent per lb. on Tin plates. This was found to be insufficient to develop the industry; as the British manufacturers dumped down, in the United States, their surplus plates, and ruined the struggling industry. It was therefore determined to increase the duty. President McKinley in reply to the Free Traders' argument said :—

“ They insist that we cannot make tin plates; so they said about steel rails, so they said about plate glass, and cutlery and pottery.”

All these industries and many others had been developed by the means of import duties. The duty was therefore raised from 1 cent to 2·2 cents per lb. This, according to a Free Trader's contention should have raised the price of tin plates in the United States from 3 to 4·2 cents, but on the contrary, as the industry developed the price fell from 3 to 2·2 cents., in 1898, and the development of the tin plate industry has been a complete success. The production of tin plates in the United States has increased from 1,000 tons in 1891 (the year in which the McKinley Act took effect) to 412,000 tons in 1902. During this period the value of imported tin plates amounted to 1,492,000 dollars paying duty, but subject to a draw back of 99 per cent. if exported in a manufactured form.

The United States Census of 1900 shows that there has been an increase of 104 per cent. in the number of fruit and vegetable canning establishments since 1890—an increase of 73 per cent. in the amount of wages paid in the same industry, 101 per cent. increase in the cost of fruit and vegetables canned, and 89 per cent. increase in the value of the completed product. The average cost of tin plates for 11 years after the McKinley Tariff was imposed has been 2·65 as against 3 cents per lb. in the years 1890-91. When the tariff was first imposed the cost

of tin plates, instead of rising steadily fell, although there was a large import the foreigner paying duty. The great development of the canning industry and the consequent demand for tin plates has tended to a temporary rise in the prices, and this was increased by the great coal strike, as well as by the strike in tin plate operatives who obtained a rise in their wages; but the average price of 1902 was not higher than in 1891.

Now to sum up the results:—

- (1) The industry of canning fruit and vegetables has largely increased.
- (2) The amount paid in wages has also increased.
- (3) The amount of fruit and vegetables used for canning has increased.
- (4) The tin plate industry has been successfully developed and the Welsh monopoly broken up.
- (5) Capital has been largely attracted to the United States.
- (6) There has been a large increase to the revenue from duty.
- (7) The cost of the tin plates has been reduced to the consumer.
- (8) The wages of the tin plate operatives have been raised.
- (9) The payment which formerly went abroad for tin plates now circulates through the wage earners amongst retail traders and gives additional employment to the industries allied to the tin plate industry, such as the chemical, iron, mining and others.

Sir Lyon Playfair, the Champion of the Cobden Club, was right when he said in condemnation of the McKinley Act:—

“If the Americans be right in principle and if they be successful in practice, the whole of the policy of the United Kingdom is founded on a gigantic error and must lead to our ruin as a commercial nation.”

The McKinley Act has proved to have been successful beyond all anticipation, even of its most sanguine supporters.

The following incident furnishes an example of the effects of dumping on a struggling industry. In 1846 when the United States were struggling to develop their iron industry, iron rails were sold in the United States for 50 dollars a ton under import duties, but as soon as the tariff was removed, the British manufacturers dumped on the United States market rails

at 40 dollars a ton and then, having ruined the struggling industry, raised the price to 70 dollars.

The history of the United States proves that there have been several periods during which, under the influence of economic charlatans, the Government has relaxed its policy of protection. Such periods have been marked by depression of trade and distress, whilst the periods of strict protection have been marked by activity of trade and general prosperity. For details of this see Appendix No. 2.

None of the prophecies of the originators of the policy of Free Trade have been realised. In 1844 Cobden prophesied:—

“In ten years from the time when England inaugurates the glorious era of commercial freedom, every country will be Free Trades to the backbone.”

Again he prophesied in 1846:—

“There will not be a tariff in Europe that will not be changed in less than 5 years to follow your example.”

More than half a century has elapsed and Free Trade is either an English or a savage custom. Not a single civilized country, except Denmark, has followed our example, but in most countries tariffs are increasing in intensity. Again in 1844 he prophesied that agriculture would flourish under Free Trade, and no interest would receive so much benefit from the Repeal of the Corn Laws as the farm tenant interest. But our agriculture has been ruined, millions of acres have gone out of cultivation and both farm tenants and landholders have lost their capital, property has been constantly changing hands, and freeholds are heavily mortgaged.

I have already pointed out that the British Fiscal Policy of unrestricted foreign imports, though claimed by free traders to be based on the political economy of Adam Smith, is absolutely opposed to it. Adam Smith, in his “Wealth of Nations,” rightly directed much argument against “monopolies,” “absolute prohibitions,” and “high duties” which amounted to a prohibition. He only advocated the free import of foreign corn on the assumption that it would be so small that it could affect very little the interests of the farmers of Great Britain. Of course he could not have foreseen that steam navigation and railways, which did not exist in his days, would entirely change the conditions of import, and would enable the actual import of foreign corn to be more than two thousand times as great as

the quantity on which he based his assumption. He actually predicted the ruin, which has already befallen many of the British manufactures, in the following terms:—

“If the free importation of foreign manufactures were permitted several home manufactures would probably suffer, and some of them perhaps go to ruin altogether.”

Both he and Mill advocated the imposition of countervailing duties on those foreign nations which restricted, by high duties or prohibition, the importation of produce into their countries (See Appendix 3).

In conclusion, I would recommend to the Provincial Committees of the Industrial Conference a careful study of “Facts for Fiscal Reforms”, which I compiled four years ago for the information of the working men’s Tariff Reform League of Birmingham; (See Appendix 4), and I would suggest that the following Resolutions be submitted for the consideration of the next Industrial Conference.

*Resolutions.*

Resolved.—That this Conference urges on the Government of India:—(1) To inaugurate a carefully considered policy of moderate import duties, which will not only yield a revenue that will relieve the land of the dead weight of taxation, but will also protect the industries of India from unfair and unrestricted foreign competition. (2) To foster International and Inter-Colonial trade by the exchange of mutual Concessions and preferential treatment with the Colonies and Great Britain.

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## APPENDIX I.

### EXAMPLES PROVING THAT THE IMPOSITION OF A TARIFF DOES NOT NECESSARILY RAISE PRICES.

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If America had pursued the policy of free imports she could never have developed her manufactures, but would have remained a huge agricultural country, exchanging her agricultural produce for British manufactures even as it is she experienced the greatest difficulty in developing her resources. Whenever she attempted to start an industry the British manufacturers killed it, by dump-

ing down upon her a quantity of materials at low prices, and again raising the price as soon as the struggling industry had been ruined. It was only by imposing tariffs that such industries could be developed. But such import duties did not necessarily raise prices. Germany experienced similar difficulties with her iron and steel industries which were swamped by English produce and almost extinguished, until Bismarck infused new life into these moribund industries, by the imposition of heavy import tariffs which have enabled Germany, not only to develop the industry, and compete successfully with us, but even to import into England large quantities of iron and steel rough and manufactured.

The manufacture of steel rails commenced in 1867 ; at that date steel rails cost 150 dollars per ton ; the duty was changed to 28 dollars per ton, and in 1872 the price had fallen to 112 dollars ; in 1874 it fell to 49 dollars ; in 1876 to 59 dollars : and in 1885 to 27 dollars.

Sir Lyon Playfair the Apologist for the Cobden Club has endeavoured to account for this fall by improved process of manufacture, which of course has some slight share in it, but the only improvement that would very materially cheapen the cost of steel rails is the Bessemer process, which was invented as early as 1855 and was in full use long before the dates above mentioned. The reduction of price is fully accounted for by the fact that between 1868 and 1899 the output of steel rails in the United States increased from 8,618 tons. to 2,270,000 tons, whilst the output of the United Kingdom decreased from 1,019,000 tons in 1890 to 838,000 tons in 1899.

The Manager of the Barrow Steel Company stated in evidence before the Royal Commission on Trade depression that in one year, 1884 his Company had paid £160,000 duty to the United States.

Mons. Theirs in his speech of January 22nd 1870 stated that a tariff on Linen and Cotton thread had reduced the price of a kilogram of linen thread from 7 to 3½ francs, and that the price of Cotton Thread had been reduced in similar proportion ; the British monopoly having been killed by the tariff.

Under the high protective tariff in the United States, between 1860 and 1883, Cotton hosiery was reduced to nearly one-half the price prevailing in 1860.



In 1867 a protection duty was imposed on wool. In 1872 there were, in the United States 143 looms producing 1,500,000 yards of Brussels tapestry; in 1880 there were 1,070 looms producing 16,950,000 yards, and the price fell from 2.30 dollars in 1872 to 1.50 dollars in 1880 and to 93 cents. in 1890.

Mr. Wycoff, United States Census Agent, stated that the average decline in the value of silk goods was not less than 25 per cent. probably as much as 50 per cent. in 15 years.

Salt under a tariff fell in price from 1 dollar and 80 cents. in 1866 to 74 cents. in 1882.

Mr. T. Dudley formerly United States Consul at Liverpool, gave the following rates of fall under the protective tariff between 1861 and 1883.

Cotton Goods	..	..	25 per cent.
Woollen Goods, Carpets, etc.	..	..	25 do.
Silk	..	35 per cent. to 40	do.
Crockery	..	„ do.	37 do.

In 1860 the duty on Crockery was 24 per cent. The tariff was increased to 40 per cent, which afterwards raised to 55 per cent. advalorem, and now many kinds of crockery are sold in the United States at lower rates than in England.

The "American Economist" of October 2nd, 1891, gives the average retail prices of fifty-six articles in common use, at three periods. In the first column is shown prices in 1857, near the close of the last Free Trade of the United States; in the second column are the prices in 1889, a year before the MacKinley Bill passed in; the next, or third column, is given the prices of 1890, during the electoral campaign; whilst the last column gives the prices after the passing of the MacKinley Act. About four weeks previously a letter was sent to 1400 official correspondents of the American Protective Tariff League, asking them to get these prices from the merchants of the vicinity. The returns have been most complete. In many instances the testimonies of three and four merchants are given. The correspondents did not ask a dealer's politics; they were simply instructed to get actual retail prices as they existed at the periods stated.

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## HAND-LOOM WEAVING IN INDIA.

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IN my paper on Hand-loom Weaving, read before the last Conference at Benares, I tried to show that, if certain improvements be made in the hand-looms and preparatory machines, the increased production would exceed the total imports of cotton piece goods into the country. The following further calculation will make the idea clear :—

The production of hand-looms working in the country is estimated at 165 crore yards. The looms work at an average effective speed of twenty picks per minute, and if this can be increased to 50 picks, the increased production of the same number of looms would be  $247\frac{1}{2}$  crore-yards. This increase more than equals the total cloth imports of the country. As this increase can be produced by the same number of men as now engaged on the looms, the price per yard will be cheaper than at present, and their ability to withstand foreign competition will so far be increased.

I have been asked to give in this short paper some idea of the manner in which this consummation can be reached. Before any conclusions can be drawn, it will be necessary to enter into some details of the various classes of cotton piece goods consumed in the country and to limit the spheres of work of the Indian hand-loom, the Indian power-loom and of foreign looms.

Beginning with the coarsest, cotton goods consumed in India may be divided into the following four classes :

- (1) Very coarse goods, using 6<sup>s</sup> to 16<sup>s</sup> counts for warp and up to 20<sup>s</sup> yarn for weft.
- (2) Coarse mediums, 20<sup>s</sup> to 26<sup>s</sup> warp and 20<sup>s</sup> to 40<sup>s</sup> weft.
- (3) Mediums, 26<sup>s</sup> to 40<sup>s</sup> warp and 30<sup>s</sup> to 50<sup>s</sup> weft.
- (4) Fine, higher than 40<sup>s</sup> warp and weft.

The following table gives a probable estimate in millions of yards of these classes of cloth consumed in the country, with their sources of production :—

No.	Class.	Warp counts.	Weft counts.	Indian hand-loom supply million yards.	Indian Mill supply million yards.	Foreign imports million yards.	Total consumption million yards.	Percentage.
1.	Coarse ...	6s to 16s	6s to 20s	900	60	300	1,260	26
2.	Coarse medium..	20s to 26s	20s to 40s	150	500	1,100	1,750	37
3.	Medium ...	26s to 40s	30s to 50s	450	40	750	1,240	26
4.	Fine ...	over 40s	over 40s	150	...	350	500	11
TOTAL ...				1,650	600	2,500	4,750	100

The bulk of the very coarse classes is woven on Indian hand-looms from Indian mill-yarn. This yarn is made from very inferior cotton and is not given a proper twist for warp. Some of the Bombay mills tried to produce this class of cloth, but the yarn could not stand the speed of the power-looms, without a sizing of from 50 to 100 per cent., and as the people wanted cotton rather than size in the cloth they bought, the mills had to give it up as a bad business. This cloth is very thick, warm and durable and is made everywhere in the country for local sale. This class may, therefore, be considered as coming within the absolute sphere of the hand-loom. Foreign cloth of this class in coloured designs and checks is being imported, but the weavers in Gujarat, Northern India and most other parts of the country, including Assam, are now producing such cloth and with increased local production the foreign article may, for the most part, be supplanted.

The main bulk of the coarse medium class is made up of imported shirtings and Indian mill made shirtings, Chadders T-cloths, &c. This class forms over one-third of the total cloth consumption of the country and the supply is almost equally divided, between the Indian and foreign power-looms in grey goods, while bleached and coloured goods of this class come mostly from the United Kingdom. The hand-loom has a very small share and produces goods of mixed colours. Coloured yarn does not

take size enough to satisfy the Indian mill-owners and they would not take to it, so long as the plain business is profitable. Coarse medium yarn is very strong and can stand any amount of rough usage in the power-loom and the hand-loom has, therefore, no ultimate chance against it. The yarn required for this class can all be produced from Indian cottons and the question of relieving the foreigner is one of time only.

The medium class consists mainly of dhoties, saris, &c., consumed by the large body of the Indian middle class. Indian cotton is unsuited to produce warp yarn of this class, while the weft yarn produced by the Indian mills is used up in weaving cloth of the coarse medium class by powerlooms. Competition in this class is between the foreign looms and Indian hand-looms both using foreign yarn. A cheap machine, cheap home labour and the production of stronger cloth on account of proper dressing of yarn, are in favour of the hand-loom workers, while the power-looms cannot work so fast on this yarn, as on the coarse medium. If, therefore, as postulated before, the hand-loom can be made to produce  $2\frac{1}{2}$  times as much as it now produces, the extra production will cover all the grey goods of this class imported, leaving the supply of bleached and coloured or printed goods to foreigners. The Swadeshi protection can help the hand-loom workers in this class a great deal, towards passing over the period of transition.

The production of the fine class is restricted to hand-loom and foreign power-looms, and the speed at which the power loom can work on fine yarn being still further restricted, the hand-loom ought to be supreme in this class of work. The difficulty, however, comes in the want of bleaching and finishing. Of the 350 million yards of foreign imports, white mulls and nainsooks make up between them 333 millions. Both these cloths can be produced on hand-looms, especially, in the humid districts of Madras and Bengal, but the Sun pleaching process adopted in the country, neither gives a fine feel to the cloth nor preserves its strength. Central bleaching and finishing factories in the fine weaving districts can alone help the weavers to get the upper hand in this competition. Recent experiments have shown the feasibility of producing Egyptian cotton in Sindh, Egyptian and long stapled tree cotton in Gujrat and American cotton in the United Provinces. With these cottons and proper arrange-

ment for humidifying, mills in India equipped for fine spinning can easily compete with foreign mills in producing yarn up to 100 counts. When that day comes, the hand-looms can get a still greater advantage with the cheaper Indian yarn.

This enquiry into the details lead us to the conclusion that four factors have stood the greatest friends of the Indian weaver.

- (1) His slow speed of work.
- (2) Cheap machine and home labour.
- (3) Light sizing and proper dressing of yarn.
- (4) Production for local consumption.

In any efforts to improve his lot, these should not be lost sight of, and yet, the speed of his work should be increased in order that he may live and successfully compete. How far can this be attained is, therefore, the first point requiring consideration.

*Speed of Hand-looms*:—Mr. Wallace, of the *Indian Textile Journal*, says:—"The object of the inventors should be to ascertain the best possible working speed, in picks per minute of the average weaver and then to adapt the mechanism of the loom to withstand this strain of work." Our enquiry suggests the addition of a rider to this proposition to the effect, that this speed should be restricted to the maximum working speed, that the yarn at the weaver's command would be able to stand in the climate at his disposal. Previous experiments undertaken during 1905 with various kinds of looms, and weavers from Gujrat, United Provinces and Bengal showed, that 100 to 120 picks per minute was the highest that an average Indian weaver could do. Experiments during 1906 have shown, however, that under the conditions enumerated above a working speed of steady 70 to 80 picks on a 45 inch loom is all that should be attempted. Higher speed than this brings in its train so many breakages of warp threads, that the effective speed is greatly reduced. An example taken from a high authority will make this clearer.

Mr. A. Chatterton, the director of Industrial enquiries in the Madras Presidency, in a note submitted to the Madras Government says, that at Ahmednagar, Hungary cloth of 10s yarn 30 inches wide and 28 picks to the inch was made on Churchil looms, the production in a day of 8½ hours being 30 yards. He mentions in the same report that the working speed was 160 picks per minute. The following calculation will show the effective speed :

$30 \times 3 \times 12 \times 28 = 30,240$  total number of picks in the day.  
 $8\frac{1}{2} \times 60 = 510$  minutes, working time.

No. of effective picks per minute =  $\frac{30,240}{510} = 60$ .

The loss of time in stoppages, due to breakages, must have been great.

*Effective Speed* :—In working every loom stoppages are unavoidable. They are due to:—

1. Changing pirns in the shuttles and breakages in weft.
2. Flying out of shuttle.
3. Fixing temple and taking up cloth.
4. Breakages in warp.

The time taken in changing pirns may be minimised by having a large pirn and a proper winding apparatus. The six-inch pirn taking up about a hank of 40s yarn adopted by the power-loom may be taken as the limit in size. With such a pirn properly wound so as to minimise weft breakage, and the loom working at 80 picks, the time taken in stoppages may be reduced to 4 per cent.

Flying out of shuttle is mainly due to faults in construction of the loom, unequal wearing of the shuttle and shuttle race, irregular working and high speed. All these can easily be avoided and even a shuttle guard can be added to the hand-loom sleys. Under proper conditions  $\frac{1}{2}$  per cent. will be ample allowance for this.

The time taken in taking up cloth and fixing temples every time after weaving six inches of cloth or so, amounts to over 12 per cent. Fixed temples with automatic taking-up motion is thus a necessity, not only for the production of even texture in cloth, but also for the saving of 12 per cent. in weaving labour.

Breakages in warp in what are called improved hand-loom take up the most time, and it is due to this, that the Indian weaver cannot be induced to adopt them. If a loom can be shown working faster than his own, on medium counts without more breakages than in his old loom, he would be quite willing and ready to adopt it. These breakages are due mainly to:—

1. Bad construction.
2. Bad beaming.
3. High speed.
4. Want of correct hygroscopic condition.

The first cause can be removed by the use of wood-working machinery and proper tools.

Bad beaming has probably a greater influence on breakages than any of the others. Weavers cannot be expected to invest in costly machinery for sizing, dressing and warping and the warps made and dressed in the country fashion, which gives a special advantage to hand-loom cloth, cannot properly be beamed by hand. The tension in the threads is uneven and causes a large number of breakages. The same difficulty was found in Baroda and the finding of a cheap beaming machine for country warps has given us more trouble, than any of the other appliances. We have at last succeeded in making such a machine and breakages are reduced by over 60 per cent.

It is really surprising, how there are practically no breakages up to a certain speed, and how fast they increase, as the speed is increased beyond the limit. This limit varies with the kind of yarn, the number of threads per inch in the reed, the breadth of cloth, etc., but a steady working spread of 70 to 80 picks on a 45-inch loom may be taken as a fair limit. The speed should be really limited, not by the number of picks per minute but by the shuttle velocity. Taking an average maximum shuttle velocity of 10 miles per hour, that the hand-loom yarn may be expected to withstand under the best conditions, the highest working speed for the various sizes of looms may be stated as follows.—

				Picks per minute.	
Loom to weave	27	inches	cloth.	117	do.
Do.	36	"	do.	97	do.
Do.	45	"	do.	84	do.
Do.	54	"	do.	72	do.

These speeds are in the inverse proportion of 5, 6, 7 and 8, respectively.

To maintain a proper hygroscopic condition, the Indian weaver has stuck to his pit for ages. The only advantage of frame looms is that they can be put upon upper floors where land is dear, but even the power-loom factories have their looms on the ground floor and that ought to teach intending investors in hand-loom, that the nearer they have their looms to the ground, the better it is for their working. When the open part of the warp rests on a pit, in which a pail or two of water may be thrown when necessary, the dry surrounding air has very little

action on the warp and it can be kept in proper condition for weaving without breakages. This seems to be the simplest and cheapest form of humidifiers and suits the hand-loom conditions admirably.

With these arrangements and a restriction of speed to 70 to 80 picks in a 45 inches loom, the breakages can be minimised and the stoppages due to them reduced to a maximum of, say,  $12\frac{1}{2}$  per cent.

The total stoppages under these conditions, viz., properly constructed looms, with large pirns and good winding, good beaming, a proper taking up motion and a restriction of speed as above, may amount to as low as 17 per cent. Allowing double the time for stoppages as an average and making it one-third, and working at a steady speed of 75 picks per minute on a 45 inches loom, the effective speed would be 50 picks or  $2\frac{1}{2}$  times the present effective speed of hand-looms. 50 picks effective on 45 inches loom with 40s yarn, will be equal to 57 picks effective on a 36 inches loom or nearly the same as Mr. Churchill's loom working at 160 picks on 10s counts. The average effective speed of Bombay power-looms on coarse medium goods is only about 100 picks per minute or double the effective speed of a properly improved hand-loom and on medium and fine goods, the power-loom will have a still small advantage.

The results of our enquiry may thus be summarized :—

1. The sphere of hand-loom influence being to some extent limited, all efforts should be directed towards the increased production of very coarse, medium and fine counts weaving, and of mixed coloured and check designs of all classes of goods, leaving the weaving of coarse medium class to the power-looms.

2. For this work cheap looms should be constructed with proper taking-up motion and allowing easy working at a steady 10 miles an hour shuttle velocity or 80 picks per minute on 45 inches cloth of 40s counts, without undue breakages.

3. The best looms for Indian use would be those that can be adopted to general purposes of weaving and not such as can be used for only simple cloth or twill.

4. This speed should be maintained with a full pirn of 6 inches taking about 840 yards of 40s or half that length of 10s counts.



5. Cheap beaming machines for properly beaming country-dressed warps should be adopted.

6. Proper pirn winding machines to wind firm conical pirns are necessary.

7. All efforts at producing, sizing and warping machines should be directed to preserving the use of the country system of sizing and dressing, and to accelerating the speed of work, sizing machines of the slasher type being entirely unsuited to hand-loom work.

For the last two years, there has been a great activity in the country in producing hand-looms of various designs and machines for preparatory processes, and every maker applauds his own goods. Many people have bought during the last year these so-called improved looms and appliances and found them unsuitable, sometimes for want of a proper understanding of the business, but mostly on account of the machines themselves, being unsuitable. There is thus a great necessity of authoritative examination and report of all these machines which the people can take as a guide. There is sufficient material for such an examination in the Calcutta Exhibition, and I would strongly recommend the appointment of an expert Committee by the Conference, to thoroughly test the loom section exhibits on the lines suggested by our enquiry, and publish a report. Any time given by busy men to this work and money spent by Conference will, in my humble opinion, be well spent in the country's service and will not be grudged by the assembled patriots.

*Introduction.*—Having thus fixed the best looms and appliances, the next great question will be how to introduce them to the weavers and extend their use as quickly as possible. The most practical ways that suggest to me are:—

1. Weaving schools.
2. Object lessons.
3. Monetary help.

*Weaving Schools:*—Many weaving schools have been and are being started in the country, but few possess a well equipped weaving factory, and without such a factory attached, where all preparatory processes and weaving in various branches suited to Indian conditions can be practically taught, the benefit derived from such schools will be very little indeed. The Committee

proposed above should be asked to recommend the proper equipment for school factories, and at least one school with such a factory attached should be started in every district. Baroda has sent in a model school factory to the Exhibition, and I would request every member of the Conference interested in the industry to visit it. Any suggestions for additions and alterations will be gladly received and attended to. Such a factory, completely fitted up, ought not to cost more than Rs. 2,000 to any district, and I am sure the district leaders can easily find this capital. If proper fees be charged to cover the tuition charges and wastage of yarn and material by new students, a school with a factory as suggested and about 40 students, would pay all its expenses. Both theory and practice should be taught, and proper attention paid to designing. It is said that the Indian weaver, with his inherited skill, cannot be matched in designing, but I am afraid that is an assumption not borne out by facts. Even in Benares, the home of design work in India, there are very few designers and all weavers in the sacred city have to dance attendance on these Ustads and their Chelas for the ground work of their sarees. At least one large well-equipped institution in every province for training of teachers and designers is also an absolute necessity.

*Object Lessons* :—In every weaving centre, nay in every village, with a considerable number of weavers, men trained in these schools should be set up with improved appliances to weave the class of cloths, that may be the speciality of the place when once the weavers see that more work is turned out than they can do with their looms, they will not require any coaxing to adopt them. This can be done by every Swadesher with his small capital, not as a philanthropic work, but as a business. A few improved looms with a beaming machine can be set up either on his own account or lent to local weavers on condition, that they would pay for them by instalments after perfectly satisfying themselves, as to their usefulness.

*Monetary Help* :—Local capitalists and associations can do a very great deal in this direction. They can advance money for looms and improved appliances, for yarn, store, etc., and take the cloth produced for sale. In this way while helping the weavers, they would help themselves in earning a very good interest on their capital.

The Government of India have recently placed before all local Governments a comprehensive record of the results of the recent movement in this direction, and many of the Provincial authorities are arranging to open weaving schools in suitable centres. The efforts of the Sholapur Municipality in financing the local weaving industry have been crowned with great success, while successful co-operative weavers unions have already been started at Benares and in some towns of the Madras Presidency.

It will not, therefore, be considered too much to hope, that, with a cordial co-operation between the Government and the leaders of the people, as represented by the Municipalities, Local Boards and members of the District Associations of the Congress and the Conference in this matter, our country may once again attain to one of the highest positions in the production of cloth, and bring back the smile of satisfaction to those engaged in the industry, which holds the second place among the occupations of the country and the first among industries.

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## RICE MANUFACTURE.

MR. HENRY H. GHOSH

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THE conditioning, husking and cleaning of paddy or 'the manufacture of rice' as it is briefly termed in America being associated in this country with the cultivation of paddy has so far received very little attention. But in America, Burma and Siam it is worked as a manufacturing industry which is the more correct system as the processes relating thereto are quite distinct from the agricultural operations connected with paddy. This system of separating the agriculture and manufacture of a great produce has been adopted in India with regard to wheat, and there are sufficient grounds for introducing it in the case of paddy. The manufacture of rice in this country is an extensive industry. The value of rice produced here far exceeds the value of all the other agricultural produce of India put together. At the opening of the Pusa Institute, the Revenue and Agricultural Member, Sir Denzil Ibbetson, said that he calculated the total value of the agricultural produce of India to be £349 millions and the "Agricultural Statistics of India" shows that about 29 million tons of rice valued at £190 millions are annually prepared in this country. The preparation of rice is, therefore the most valuable manufacturing industry in India, and if the statistics of other great manufactures, were examined, I should not be surprised if it turned out to be the most valuable manufacturing industry in the world. This enormous industry is, however, being conducted at present on the most primitive methods which are extremely slow, laborious and expensive, to persist in which would not be sound economy. Apart from the question of reducing the cost of production and thereby lowering the price of the staple food of this country, when you consider the vast amount of time and labour wasted on this industry which may be more profitably employed in others—of which the cultivation and manufacture of cotton may be named—you will agree with me that our industrial economics is still in a very backward condition and urgently needs a proper adjustment. Public attention has already been drawn to this manufacture by the *Statesman* newspaper. Considering the vastness of the

industry and the bright vista of economic possibilities it opens up before us, I think this subject commends itself to our very serious consideration. Having manufactured rice for a few years in this province, I think I am able to form some idea of the improvements that may be made in this industry.

The indigenous method of rice preparation in which the pounder (*dhaki*) or the mortar and pestle (*hath-masuli*) plays an important part is too well known to need description. The method, apart from being extremely crude, tedious and expensive does not yield a clean produce, free from impurities. The average cost of preparation by this method is  $6\frac{1}{2}$  as. per maund of rice considering the low value of agricultural labour in this country. This cost increases to about 7 as. for boiled (*ushna*) rice and decreases to about 6 as. for unboiled or sun-dried (*alloh* or *attob*) rice. The working time required by one person to prepare a maund of boiled rice by this method is about 21 hours. This is made up as follows:—1 hour for paddy-clearing,  $\frac{1}{2}$  an hour for putting into and taking out of water the paddy (the soaking which occupies about 24 hours requiring no attention) 2 hours for boiling and  $1\frac{1}{2}$  hours for drying it (although the paddy remains in the sun for about 5 hours) one person working all this time. The husking and cleaning of the paddy in the Dhaki is always done by two persons who would together take about 8 hours. For purpose of calculation this would be equivalent to 16 hours for one person, making up a total of 21 working hours. Similarly, a maund of unboiled rice would take about 1 hour for clearing, 1 hour for drying and 16 hours for husking and cleaning, making up a total of 18 working hours. Calculating the value of the labour at 3 as. per day of 9 working hours, the cost of 21 hours' labour would be 7 as. and of 18 hours' 6 as. being respectively the cost of preparing boiled and unboiled rice. This average cost of  $6\frac{1}{2}$  as. also coincides with the rate paid to hiredworkers for rice preparation in certain parts of Bengal which is generally 6 as. per maund of rice, the worker retaining the half a maund of husk which may be valued at half an anna.

Before going further into this subject, it may be mentioned that the cost of rice manufacture varies mostly with the quality of rice wanted whether boiled or unboiled polished or unpolished but that it also varies slightly with the quality of paddy used.

In coarse paddy, the cost is somewhat lower than in fine paddy. The aforesaid cost is for medium qualities only. It may also be observed that a maund of medium quality of Bengal paddy would yield about 26 seers of rice, 13 seers of husk (*thoosh*) and 1 seer of meal (*kuro*); and that the yield of rice increases slightly in coarse paddy and diminishes somewhat in fine paddy.

It would not be possible for me to state within the limits of this paper the principles upon which rice is manufactured in America and Burma, but I shall here describe in the briefest outline a fairly efficient and economic system by which rice manufacturing may be initiated in this country. This system is very similar in most of its processes to either the Rangoon or the American system and, I may add, that I have attained rather satisfactory results from it.

#### CONDITIONING.

*The separation or refraction.*—However much Bengal paddy is fanned at the time of purchase, there is always a certain percentage of refraction in it such as balls of mud, bits of stick and straw which have to be separated from the grain. When unboiled rice is wanted, this is done by a ‘circular motion separator’ as in Rangoon. This separator consists of a set of sieves circulating in one plane and requires very little power to drive. When boiled rice is wanted the separation or refraction is effected by specific gravity in the soaking process.

*The soaking process.*—Previous to being boiled, paddy is soaked in fresh water for about 24 hours which softens the husk and clears it of all admixture. The balls of mud dissolve in the water, the paddy sinks to the bottom of the vat and the bits of stick and straw float up which are then easily removed.

*The boiling operation.*—The paddy is then partially boiled which renders the rice wholesome from the consumer’s point of view and facilitates the husking process from the manufacturer’s standpoint as we shall presently see. Par-boiling is done over fire in the indigenous method but I have found that, when effected by steam, the operation becomes infinitely quicker, far less laborious and more easy to regulate. This is done in a boiling apparatus where steam is introduced by means of a connecting pipe. No water is needed and decidedly better results are obtained.

*The drying process.*—Whether for boiled or unboiled rice, paddy is dried in the sun by the indigenous system to facilitate the husking operation. How boiling and drying helps the husking is easily explained. Boiling inflates and drying contracts the body of the grain, the resultant of these two actions is to partially release the husk. Drying alone has this effect to a very slight extent. Unboiled paddy takes about three hours and boiled paddy about five hours to dry in the sun but the grain must be stirred now and again.

I may now say that the question of drying boiled paddy has always weighed heavily on the minds of those acquainted with this industry and interested in its development. In this country there is a very extensive consumption of boiled rice, the unboiled rice being used by very poor people who find it more sustaining. In Burma also both kinds are prepared, perhaps more of the latter as her exports are of this sort. But in America only unboiled rice is manufactured. This difference of equality is due in a great measure to the various purposes for which the rice of these countries is required. Indian rice is used exclusively for food, Burma rice for food, distillation and starch, and American rice for food and confectionery. But I fear that the difficulty of drying has been greatly exaggerated in this country. Because by the indigenous method even unboiled paddy is dried in the sun before being husked, an erroneous idea prevails among some of us that this process would be needed for this paddy if husked in the machine. But such would not be the case, for both in Rangoon and America unboiled paddy is husked in the mills without any previous process of drying; and various qualities of Bengal paddy, unboiled and without any special drying, have been husked very satisfactorily in the Engelberg and Cowie's Hullers. Of course, it is always understood that well-matured and naturally dried paddy is to be put into the husking machine. The only question with us, therefore, is the drying of boiled paddy. This can always be conducted under a tropical sun to a limited extent. I have myself dried boiled paddy regularly in the sun on a large platform which, I am told, is also done at the Coconada Rice Mills. Daily a hundred or two hundred maunds of grain can be conveniently dried in this manner if there is sufficient ground for the purpose. But the treatment of larger quantities in this way would become rather

cumbrous. Attempts have, therefore, been made to dry boiled paddy artificially both here and in Burma, but none with any satisfactory result. Hot air has been always used in the process and though the drying has been somewhat successful, the colour of the rice has never been as clear and white as that of the sun-dried grain. But there is no reason why we should give up hope in this matter when tea and particularly wheat, about the colour of which consumers are very fastidious, are now being artificially dried. Indeed, I believe it is Gibb's Wheat Dryer that has showed the best results with paddy up to now, and it is quite possible that Messrs Thos. Robinson and Son, Ltd., of Rochdale, makers of the celebrated Mallinson's Wheat Dryer, will be able to present a perfect paddy-dryer if they find a market for it. I may here mention that Mr. Rakhal Dass Khan, rice-huller maker of Sulkea, has recently supplied to a Chetlah miller a paddy-dryer which dries boiled paddy with a certain amount of success. But it does not treat more than about 40 maunds of grain in 8 hours, four coglies working at it. As it stands, therefore, his process is no better nor cheaper than the sun-drying process.

After treatment in the aforesaid manner, the paddy is brought to a condition fit to be husked. There are several machines on the market for preparing rice. In England, rice mill machinery are constructed by Messrs. Hind and Lund, Messrs. William R. Dell and Son, of London, and other makers. In Germany, F. H. Schulze, of Hamburg, manufactures rice plants, notably a polishing machine which is called his 'Pearler'. It is, however, noteworthy that some of the best rice-milling machines come from America and Burma.

#### HUSKING.

The principle by which paddy is husked in the indigenous method, and which is followed up in all husking machines, is the application of friction and pressure. On a small scale the most complete and satisfactory husking machine is the well-known Engelberg Huller No. 2, which husks about 60 maunds of medium Bengal paddy in 8 hours. The price of the huller is Rs. 700. Mr. Rakhal Dass Khan, of Sulkea, has also constructed a rice huller which, I believe, is giving satisfaction to a Chetlah miller. I am told that it husks about 40 maunds of paddy in 8



hours and costs only Rs. 300. The cost of replacing wearable parts in this machine is little compared to the expense of changing the blade and screen in the Engelberg. Khan's Huller is, therefore, well worth a trial. As for the hullers constructed by the late Jogodiswar Ghatak, I regret I am unable to say anything in their favour. But the husking machine, that has so far given the best results with Bengal paddy, is Cowie's Huller made in Rangoon. The machine entails the erection of a plant (with double fan, elevator and direct-acting sift) which cannot be done with a small capital. The outturn of this huller, made in different sizes, ranges from 100 to 200 maunds daily of brown rice.

#### CLEANING.

When paddy is husked it is technically called 'brown rice,' owing to the brown coating below the husk which now appears. The removal of this coating is called the cleaning process in which there is more friction applied than pressure.

A good cleaner for a small mill has not yet been put on the market. Engelberg Huller No. 1 is about the only machine that serves the purpose if the skin in its lower cylinder is replaced whenever it wears out. Unless this is done the rice gets slightly discoloured. The White Rice Cone made in Rangoon is, however, an excellent cleaner, the product from it satisfying the most exacting market. It has a large capacity but is an expensive machine.

#### POLISHING.

When brown rice is cleaned it is technically known as 'white rice.' Polishing is the process by which the surface of white rice is glazed. This treatment is only necessary for rice that is exported. Schulze's Pearler has turned out perfectly polished rice at the Ramkristipur Rice Mills, Ltd.

Rice cleaning and polishing, which is a portion of the industry here advocated, is not new to the country. This system of rice milling entirely for the export trade has been carried on for several years at Ramkristipur and Chetlah near Calcutta, and the complete manufacture of rice is now conducted by a handful of millers scattered about in North-Western India and the Madras Presidency. But the only reason I can attribute to

the slow growth of the industry is that, unlike the other countries, boiled rice is largely consumed here and the difficulty of paddy drying has always loomed very large in the minds of those that have from time to time been enquiring about it. Had they been reasonable in their apprehensions, the problem of drying might have been solved ere this. I have often tried to correct false notions regarding this industry, but my endeavours have been futile.

By the system above stated the cost of rice preparation per maund would be approximately 2 as. 6p. for unboiled and 3 as. for boiled rice, unpolished, such as would be needed for home consumption. Rangoon millers reckon an average of 3 as. as the cost of preparing polished rice. If a system of artificial drying is introduced, the cost of boiled rice should be reduced by 6 pies approximately. It will, therefore, be evident that, by the introduction of the Rangoon and American systems of manufacture, the price of the greatest staple food of our country will be reduced by about four annas on the maund and an enormous quantity of labour will be set free for more profitable industries.

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## THE DEVELOPMENT OF INDIAN SUGAR INDUSTRY COUPLED WITH AGRICULTURE.

MR. HARIDAS CHATTERJI, M.A., B.L.,

*Pleader of Khandwa, C. P. and Indore, C. I.*

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IN some Districts of the Central Provinces and in the dominions of most of the Native States in Central India, there are extensive date forests of wild and luxuriant growth. Speaking generally, the date trees in those parts are taller and stouter than those of Bengal; as they are more numerous in the villages. It is a very remarkable fact, that while the labourers and the cultivating classes in Bengal, particularly those of Jessore, Nadia, Khulna, Faridpur, &c., derive a handsome income by the manufacture of date sugar, crude as well as pure, —by tapping date trees every winter, the Central Provinces and Central India get nothing from their richer possessions of date forests; though with the exception of one very serious matter, the facilities for the production of date sugar in the Central Provinces and in Central India are great. These facilities consist of cheap fuel and cheap labour; besides, the climate of the provinces is exceptionally good. The difficulty mentioned above is the entire ignorance of the people in the date growing tracts of the provinces, how to tap the date trees and to produce sugar from the extracted juice. In some of the Districts in those tracts, there are some classes of people in the date growing villages who follow the Bombay method of tapping the date trees to make *toddy* for the purposes of intoxication under the Excise Rules in force. Like the Parsis of Behar, the date-tree tappers in the Deccan, Central Provinces, and Central India,—known by various names,—Bankaris, Bhandarias, Talvadias, &c., have no other occupation than to sell *toddy* and to supply the liquor to the Abkari contractors of the Excise Department. These tappers are extremely unclean in their habits; and are, speaking generally, inveterate *toddy* drinkers. The tapping processes they know are widely different from and are very much less artistic than those that prevail in Bengal. It has been found by repeated experiments continued for nearly three years, in certain villages in the District of Khandwa in the Central

Provinces, that by working side by side, the Bengal tappers, called *gachis* and *sheolies*, produced much better results than their brethren of the Bombay Presidency. It is, therefore, indispensable that to introduce and to develop the industry of date-sugar manufacture in the Central Provinces and in Central India, the first essential condition is to impart the knowledge of the Bengal system of tapping the date trees. The said system has the acknowledged merit of being the least injurious to the date trees, and the most effective mode of extracting the largest quantity of saccharine juice from the trees.

2. It is said that the early Bengali settlers in the Central Provinces and in Central India used to wonder why the poor villagers in those parts did not utilize the date forests and manufacture crude date-sugar. The resources of the owners of the *Sindbans*, as the date forests are called, were great for procuring any amount of the Bengal skill over a considerable area of the Province. And yet what it was to prevent the spread of the industry till now? The reason was not far to seek. It was the impression of the people that there was no other use of the date trees than that they yield intoxicating drink only. To the conservative and orthodox minds of the Deccanis of the upper and middle classes, the date trees and their juice have a sort of traditional repugnance which it has been my endeavours within the last eight years to dispel. In 1898, I imported five *gachis* from Jessore to see for myself what quantity and quality of sweet juice could be derived from the date trees in the Central Provinces, what the outturn of *gur* therefrom, and what the people would say as regards the produce. A village near Khandwa was the place of my first experiment in 1898. I found:—

(1) The yield of juice was a little less than the ordinary yield in Bengal. Only the trees standing in the cultivated fields yielded nearly the same quantity as an average Bengal tree does.

(2) The sugar percentage in the juice was much higher than the same in Bengal. That is to say, while 10 to 11 *seers* of *Jeern Ras* in Bengal produce after boiling one *seer* of *khejoor gur*, seven to eight *seers* of my juice produced the same quantity of *gur*.

Respectable people of the District, both official and unofficial, used at times to visit my little factory in the village. The villagers from all sides used to flock in numbers to see the

processes of tapping the trees and boiling the juice. All these classes of people expressed their surprize to me that though they had considered I was engaged in manufacturing a sort of condensed *toddy* or an intoxicating drug, they found that my produce was an exceedingly fine and flavoury *gur*. The taste, they said, was somewhat different from that of the ordinary cane *gur* they were accustomed to use. But in points of appearance and formation of crystals, the *gur* produced was declared to be better than the sticky mass of the inspissated cane *gur* so largely imported in the province. The superior results of the date *gur* I made just noticed above, are due to one fact; namely, the trees growing in the moist soil of Bengal yield more watery juice than those on the dry land of the Central Provinces and Central India.

3. I continued my experiments in another village of the same District (Khandwa) next year, when I sent a quantity of date *gur* for analysis to the Rosa Sugar Refinery of Messrs. Carew and Co., in Shajahanpur in the United Provinces. I was glad to read in their report that though my date *gur* was badly made, the sugar percentage therein was very high, being nearly 55 per cent. Contrast with this the ordinary Bengal percentage. Some time ago I read some official statistics of the date sugar industry in the District of Jessore. It is stated there that the quantity of pure sugar was about  $37\frac{1}{2}$  per cent.; while the rest was treacle. Following the custom of Bengal, I have made Khejoor *gur* cakes, called *patali*, and by pouring the *rab* to cool in earthen pots, produced semi-solid mass of sugar crystals mixed with treacle. I have worked the latter in the Centrifugal with success which I can hardly conceive to be possible in Bengal. I sold the separated brown sugar crystals in the local bazaars from Rs. 6 and Rs. 7 a *maund* (80 lbs.) The treacle driven off from the Centrifugal basket is readily saleable for the use of the *gooracco* maker at the rate of Rs. 2-8 to Rs. 3 per *maund*. I exhibited my date *gur* and date *gur* cake at the Madras Exhibition held in December 1903 and at the previous Calcutta Exhibition. I received from the jurors at both the Exhibitions certificates of merit to say that my article was in no way inferior to what is manufactured in Bengal. I think my article deserved a larger measure of praise with reference to the ordinary sticky *Khejoor gur* of Bengal.

4. While engaged in my works of experiments of manufacturing date *gur* every winter in the villages of the District at Khandwa in Central Provinces, I had an opportunity of being called by the Durbar of the Indore State to begin my operations in a date forest village in the Malwa. The word Malwa means the Territories of His Highness the Maharaja of Indore, a large part of the Gwalior State, the whole of the Jaora State, and the territories of Dewas, Dhar and many other Minor States in Central India. The whole Malwa, for the purposes of sugar industry, may be called a huge forest land of natural, wild, and spontaneous growth of date trees. It comprises also an area of numerous scattered *Adan* fields of good irrigation facilities where sugar-cane is now being grown, and where it can be more widely and successfully grown with better methods and in more improved style. A very limited proportion of the irrigated and irrigable fields is now being utilized for sugar-cane by the poor and extremely backward village cultivators of the Malwa country. The reasons for this sad state of things I will not stop to enquire and to discuss. But I have not the slightest hesitation to state that there is considerable room for the expansion of the sugar-cane cultivation in the villages of Malwa. Years of scanty rainfall and of famines having depopulated and thinned the villages of the Indore and Gwalior States, the Durbars at Indore and Gwalior have announced their intention to grant concessions and advantages to induce new settlements of tenants from outside. I availed myself of the opportunity afforded; and selected the culturable wastes and the date forest lines in the villages of Morad and Goknia in the Indore District which are at distances of 5 and 10 miles, respectively, from Indore. This was in the year 1902. Before starting business, I represented to the Minister of the Indore State, Rai Bahadur Nanak Chand, C.I.E., the supreme necessity of importing a set of Bengal tappers to introduce their improved methods in the villages, and applied for the grant of the promised concessions as regards the date trees and the agricultural fields in their vicinity. The Durbar of the Indore State permitted me to take ten tappers from Bengal at the State expense, and to purchase the requisite tools and plant for the manufacture of date *gur* and sugar. This I did in the winter of 1902-03; and I am glad to say, the results of my

operations were declared to be very satisfactory and hopeful for the further expansion of the industry in the State. In order to enable me to continue my business of sugar manufacture in conjunction with agriculture, the Council of Regency of the Indore State granted me the privileges of free use of the date trees for five years from 1904, and reduced rates of the rental of all the available fields in the villages, rising by slow degrees to the standard assessment rates in the course of the said five years. There are about 8,000 date trees in the two villages named above, besides numberless date plants all along the lines. The trees stand in thick clusters and in well-defined rows on the borders of agricultural lands of dry and wet cultivation. But they preponderate chiefly along the banks of the numerous *Nallas* and water courses that exist all over the Malwa country. Roughly speaking, we may fairly assume that there are about 3,000 to 4,000 date trees within the limits of a single village in the majority of villages in Central India and in the date-growing Districts in the Central Provinces; and in every date forest village there are fertile lands to raise all varieties of valuable crops for which Central India and the Central Provinces are famous. Thus there exist unique opportunities for agriculture, and coupled with it, the cognate industry of manufacturing sugar from date as well as cane throughout the length and breadth of Central India. It is, I am sure, hard to find a similar combination of facilities and advantages in any other part of India. It may be here pointed out that the industry of manufacture of sugar only, from date or cane or both, cannot possibly stand alone. It must be coupled with and be made a subsidiary adjunct to agriculture. The sugar-making industry is of the winter season only. The men engaged therein must find employment for the rest of the year, and agriculture is undoubtedly the most profitable employment. This is the prevailing and normal condition of things in all the date and cane-sugar producing Districts in Bengal. No departure therefrom is possible or advisable.

5. Here it is necessary to draw a tentative scheme of a project for agriculture with the industry of manufacture of sugar from date as well as cane, taking one village in Central India as a unit for consideration, and setting forth, *inter alia*, the following important particulars:—

I. Description of the date jungles of Malwa and of the Central Provinces, their extent, and the number of trees ; how the trees are grouped, the nature of the soil on which they grow, rent of the land for agriculture and of the date forest land ; and the climatic conditions of the provinces.

II. What are the initial difficulties for tapping the date trees and how they can be met.

III. To show that the only sound way to undertake the business is to start general agricultural farms, where—

- (a) the local crops, such as wheat, grain, opium, cotton, &c., will be grown ;
- (b) sugar cane will be largely cultivated ; and,
- (c) a large sugar industry, both date and cane, will be undertaken in the winter.

IV. Nature of the date juice of the Central Provinces and Central India as compared with that of Bengal both as to quality and quantity.

V. Available local markets and labour.

VI. And the resultant profits that can reasonably be expected from the whole business.

To consider the above points serially and in a concrete manner, I will take Morad, the seat of my own farm, as the model, which in many respects it is, to represent the condition of things that exists in thousands of villages in the Central Provinces and Central India. I have there about a dozen plots of land of black sticky *cotton soil*, as the soil of Malwa is ordinarily called, each measuring from about six to 10 *bighas*. I do not speak of similar fields that belong to the other tenants of the village. On all sides of most of these fields there are clusters of grown-up and growing date trees, in straight lines and at convenient workable distances of from six to nine feet apart from one another. It would appear as if they have been planted with a design to enable the cultivators to follow agriculture for the whole year, and to avail of the slack agricultural season of winter to make date sugar. To facilitate irrigation there are about a dozen good wells of which four are mine. The level of water in the wells ranges from eight to 20 feet below the surface of land ; so that, lifting water by the country *mote* or pump is a



tolerably easy and inexpensive work. Over the area of about one acre of land on all sides of the well you can, as I have been doing, raise wheat, opium, potatoes, onions, brinjals, cane, &c.,—reserving the remainder of your farm for the rain crops, *i.e.*, jowari, bajri, cotton and pluses. Around each of my fields of wet and dry cultivation, there are, on an average, about 400 date trees sufficient to engage two *tappers* and two *khedis* to assist them. These *khedis* acquire the skill in about two or three seasons. The nature of the land of the date tree lines is the same as that of the adjoining fields, that is, culturable and fertile. But the clustering date trees, young and old, render ploughing hard. It needs hoeing-up by hand, and weeding in the rainy season to foster the growth of the trees, and to increase their yield of juice. Besides the date trees guarding, as it were, the borders of tenant holdings, wide and thick date forest lines run along the natural water courses, which traversing village after village, present the sight of interminable avenues of date trees which are yet untouched by human hand. I have got all my date trees in Morad rent free for five years, as said above. They are about 6,000 in number. But the average rent charge of all kinds of forest land in the villages of the Native States in Central India is very low. It ranges from four annas to eight annas per *bigha*. In the date forests, that means an insignificant trifle for about 200 or 250 date trees that certainly stand over one *bigha* of land. Public health in the whole Malwa country and of the Central Provinces is almost uniformly good.

6. Regarding the initial difficulty of lack of trained men locally, the farmer must, for the first two years, import about five Bengal tappers and associate with them his local labourers to work as *khedis* or their assistants. My own experience is that the cost of one skilled Jessore tapper for one season, including his railway fare for the forward and backward journeys, and his wages at the rate of Rs. 15 per month, is about Rs. 100. Thus for five men for two consecutive seasons, an outlay of Rs. 1,000 for importing the Bengali's knowledge of tapping is a part of the necessary sinking capital. One *khedi* for each Bengal *gachi* will not cost more than Rs. 25 for the five months of the tapping season. Rupees 25 per month for the five local *khedhis* or Rs. 125 for the season, being added to the cost of five Bengal

tappers, the total cost of labour would be about Rs. 625. To this would be added the expenses for pots, ropes, pans, and fuel which would not be less than Rs. 75 in all. I will provide Rs. 100 more to meet all possible contingencies and unforeseen charges. Against this initial cost or debit of Rs. 800 for the first starting year, no one should expect that his produce of *gur* would bring to him an equal credit amount. As a certain amount of labour would be wasted in clearing the date trees, the five *sheolies* and their *khedhis* would not be able to operate on the prescribed number of date trees which is at the rate of about 200 trees for one tapper and *khedi*. In the first year only about half the number of the trees would be tapped: and even those trees would not, on their first tapping, yield the proper quantity of juice. Like milch cows, date trees are in need of being annually tapped to bring them, so to speak, to their sap-bearing condition. So, as I have personally seen, the aforesaid batch of workers would not turn out at the rate of more than eight annas worth of *gur* from each tree. That is to say, the first year's income from date *gur* would be only about Rs. 250 for an expenditure of Rs. 800, as said above. In the second year, while the expenditure would nearly be the same, the income would slightly increase, because about 200 or 300 more trees would be reclaimed from the wilderness and utilized for the purpose of the industry. But from the third year, the costly item of Bengal labour would be, as it certainly should be, dispensed with and then the farmer scores out the sum of Rs. 500 from the debit side of his budget of date sugar expenses. But by this time, his local *khedis* will have become skilled workmen; and for this additional accomplishment they would charge Rs. 10 a month for the five months of the tapping season. Thus in successive years, the nestling *khedis* grow to become fullfledged *gachis*, batch after batch, till it becomes possible to seize all the circles of the date trees that stand within the limits of the farm. Later on, I will set out the prospects of gain, taking agriculture and sugar manufacture from date and cane within the compass of the village industries under consideration, *manned solely by the local agencies.*

7. Reverting again to our model village, Morad, we have to arrange for the cultivation of our fields, grow all the usual crops thereon, reserving every year certain areas near the wells for

the cultivation of sugar cane. But in Morad or elsewhere, in any village of any district in Central India or in the Central Provinces it is neither possible nor desirable to secure all the irrigation wells and all the available agricultural lands for exclusive use or home farm of a single person or of a group of men working jointly. It should be the constant aim of the enterprising farmer to foster and to improve the agriculture of the village, retaining for himself a certain number of demonstration plot to raise sugar cane and other crops in improved style, making advances to the poor tenants to grow sugar cane as largely as possible, and training his own and others, labourers of the village how to tap the date trees and extract the sweet juice. At the rate, say, of 200 trees for a tapper, it will never be possible to entertain 30 or 40 labourers for working in the fields of a single village-farmer. You cannot possibly expect to supplant the old resident cultivators in the villages and appropriate all their fields. The wisest and best course for you to follow would be to purchase heaps of cane which you helped others to grow, and to purchase potsful of date juice drawn from the trees growing on or near other's fields. Give me any amount of sweet juice, of cane or of date, and I shall not delay one moment to set up some kind of improved machinery to produce *gur* or to manufacture sugar in the country. It is not in the power of any single cultivator or of any group of cultivators,—for they hardly know to combine to work for common advantage, to purchase mechanical contrivances of any sort of *gur* or sugar making in improved style. Whether you take the apparatus contrived by Mr. S. M. Hadi, Assistant Director of Agriculture in the United Provinces, which is set down as one of the important items for demonstration at the present Exhibition, as it was last year at Benares; or whether you adopt the “central factory system” which the leading engineering firm at Calcutta, Messrs. Martin & Co., have now taken to introduce in this country to give an impetus to the Indian sugar industry, you must make the poor and illiterate ryots of the country the means to an end; and you must so manage your farm as to make it handy and easily accessible to the neighbouring agriculturists. Mr. A. E. Jordan, the well-known sugar expert and mechanic, has recently joined Messrs. Martin and Co., expressly for the purpose of designing sugar machinery to refine sugar and

make sugar in crystals from juice under the "central factory system." Mr. Jordan is said to have designed an apparatus for a more successful crushing of the cane than what obtains in India, and for a better and more scientific process of boiling and treating the juice to secure as much economy and profit, as done in the West Indies, Egypt and Mauritius. Mr. Jordan has personal knowledge and experience of the factories of those places which have enabled the people over there to land in this country pure crystal sugar at a cheaper rate than the cost of our country *gur*. The cost of Mr. Jordan's apparatus, made by Messrs. Martin & Co., is likely to be about Rs. 18,000 which will turn out pure white sugar at the rate of nearly two tons a day. That means the daily supply of over two tons of raw cane, or nearly 12 tons of cane juice, or nearly 20 tons of Bengal date juice, or nearly 15½ tons of date juice of the Central Provinces and Central India. How to obtain such a large supply of juice every day throughout the winter season is the most important question connected with the subject of sugar industry in India. The answer is we must follow the method adopted in other sugar producing countries in the world, as explained elsewhere in this paper. I come before you with full knowledge of the local conditions of the Central Provinces and Central India where I have lived almost the whole of my life, and I know no other Province in India where you have so many facilities to develop and to expand sugar industry with agriculture as in Central India. Therefore, my advice to my countrymen is this:—

1. Go and settle in a date forest village in the Indore, Bagli, Dewas, Gwalior, or Jaora State. Apply for land for agriculture and you will have as much as you would require or be able to manage. You will, I am sure, be granted free use of date trees for a number of years till you well settle in business.

2. You will find local labourers at the rate of Rs. 60 a year, and bullocks of the excellent Malwa breed at the rate of Rs. 100 a pair. Go on at the same time purchasing Malwa cows and calves at the rates of Rs. 30., Rs. 40, or Rs. 50 per pair. Look after them and tend them properly; and you will have a large stock of cattle for your own use and for the use of other tenants.

3. Retain as much land and cattle, date trees, &c., as you require for the full year's crops including sugar cane, and date juice from your own date trees.

4. Within the limits of your means and resources, advance money, cattle, seed, and improved agricultural implements to the neighbouring cultivators on easy terms of interest, in cash or in kind; and then you will not run the risk of loss. Offer inducements and facilities to the tenants, their labourers, and their children to learn the art of tapping the date trees that appertain to their holdings, and offer to purchase the date juice they would extract, every winter, which, while bringing you profit after being treated in your central sugar factory, will bring to your neighbours a new source of income. Lend money or your well grown sugar cane to extend the cultivation of cane far and wide under the usual conditions of purchase at the current local rate for the time being.

5. All the above you cannot do in a day or in the first year of your operations. You will have to make an honest and sincere beginning at the start, relying on your own means. If you are earnest and steady, and make some progress, you will obtain on easy terms loans from the State concerned, and then you will be able to advance loans yourself in cash or in kind, to other cultivators.

6. Having arrived at this stage of your business, you will find that, while our own agriculture is in full swing, you have paved the way for the supply of date juice and of sugar cane suited to the requirements of your central factory. Here you must remember that the ordinary country crusher of the best type or the Behia iron mills extract only about 60 per cent. of the cane juice. So that, loss or wastage of 40 per cent. is ruinous for the business of sugar-making. I have heard that the triple crushing system of Mr. Jordan's design secures 90 per cent. extraction of juice, and the crushed cane is readily available as fuel for boiling.

7. For all varieties of your crops, for your manufactured *gur* and sugar, the head-quarters of every Native State,—Indore, Mhow, Neemuch, Gwalior, Bhopal, Jaorah, Rutlam, &c., afford most convenient and ready markets, as grain of every sort sells at rates which are almost uniform all over India. Locally made

*gur* sells at the rate of Rs. 5 to Rs. 7 per *maund*, and sugar from Rs. 9 to Rs. 12 per *maund*.

8. I will not enlarge on the subject by stating in detail the prospects in gain of the whole concern of agriculture coupled with the industry of manufacture of sugar from cane and date. Confining my attention to the business of making *gur* and sugar alone, I will briefly state my own experiences of the last eight years, thus:—

(i) One trained tapper, with the aid of an assistant, can turn out not less than 20 *maunds* of date *gur* in one season from his circle of about 200 date trees. A locally trained tapper in the Central Provinces and Central India is glad to get Rs. 10 a month. His assistant would be happy if he is paid Rs. 6 per month during the winter season. Date *gur* sells in those provinces at the rate of Rs. 5 per *maund*. The total expense comes to about Rs. 80 for *gur* worth Rs. 100 : leaving a profit of 25 per cent.

(ii) I have raised one *bigha* of sugar cane at an expense of nearly Rs. 100 ; i.e., Rs. 5 for rent, and about Rs. 50 for all other items. For *gur* making or chewing purposes, the cane produced is well worth Rs. 150 bringing 50 per cent. profit on the outlay. Well cultivated, one *bigha* would grow about 12,000 stalks of more than human height of sugar cane. At the rate of one pice for one piece, the whole crop is worth Rs. 150 *on the field*. I have seen by detailed calculations and observation that one date tree yields every winter as much juice as can be extracted from about 90 well grown canes. But the difference is that the date trees in the wild forests of Central India are Nature's plantations ; whereas, the cane fields are the growth of one year's hard labour and expense. In point of saccharine properties, the date juice of the Central Provinces and Central India makes the nearest possible approach to the ordinary cane juice. Hence both kinds of juice can be treated together. The Bengal date juice is nearly half as sweet as the cane juice.

9. In the above paragraph, I have taken a group of 200 date trees and one *bigha* of cane field as the units to indicate the prospects of gain from sugar industry alone in one agricultural farm in the Central Provinces and Central India, of which hundreds can be established if our countrymen wake up and work.

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## **SUGAR INDUSTRY IN INDIA.**

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In a paper read by me before the South Indian Association, Madras, in August last, on the "Problems of Sugar Industry," the full text of which appeared in the September number of the *Indian Review*, I discussed at some length the chief problems that have been engaging the attention of cane-growers and cane-sugar manufacturers all over the world, with special reference to the condition of the sugar industry in this country. I do not think it necessary to repeat here what has been said there, but would only recapitulate the salient points. The most prominent defects in the Indian sugar industry seem to be (1) the sporadic cultivation of canes in small plots of land, (2) the waste that occurs in consequence of defective crushing in primitive mills, (3) the manufacture of raw sugar in the form of jaggery or *gur*, (4) the difficulty of transport of canes to the factory and sugar to the market, and (5) the absence of demand from foreign countries for Indian raw sugar. Attention was also drawn to the increasing demand for refined sugar and the inability of the manufacturers in India to meet that demand. It was pointed out that cheapness was the sole recommendation in favour of foreign beet sugar. The remedies suggested were (1) the application to cane of the very same methods as are adopted for the manufacture of sugar from beet on the Continent of Europe; (2) the establishment of central factories on the coast with a view to develop the export trade in sugar; (3) the extension of cane cultivation in the deltaic tracts of such rivers as the Cauveri, the Tambraparani, the Kistna, the Golavari and even the Ganges as far as possible in close proximity to these central factories; (4) the institution of a sliding scale of prices in regard to canes delivered on sale into the factories; (5) the arrangement with the Railway Companies for a reduction of fare in respect of canes brought to the factories for sale and of sugar transported to the market for consumption; (6) the utili-

zation of the labour of experienced returned emigrants in cane cultivation. Not being immediately connected with the sugar industry in any way, I had doubts as to whether I had rightly diagnosed the causes of the depression of the Indian sugar industry and had suggested appropriate remedies. I expected that those actually engaged in the industry in India would seize the opportunity to come forward and mention their troubles and difficulties. My object in choosing this subject for my paper, although I am not qualified to express an opinion, was to invite expert opinion and to draw public attention to the rapid ruin which is overtaking an industry which has existed in this country from time immemorial and which is the mainstay of a large class of people. Another industry, which had its birth in India ages ago and flourished as an important item in the export trade of the country, has almost ceased to exist owing to German competition. I refer to indigo. The large patches of blue, which represented indigo cultivation in the Statistical Atlas of India, have disappeared. The large foreign capital thrown into this industry in Bengal has become a waste and returns no profit now. The foreign capitalists are, therefore, thinking whether they cannot grow some other crops in its place. German *savants* appear to me to be the Viswamithras of the Kali age well versed in the art of duplicating nature. Their ire seems to be particularly directed against us just as Viswamithra's was directed against Vasishta. They invented artificial indigo to suppress the natural indigo of our land. They invented aniline and alizarine colours to suppress our lac dye and other natural colours. The inventor of the artificial sugar *saccharine* from coal tar naphtha is an Americo-German chemist named Fahlberg. The sugar is said to be 230 times as sweet as cane sugar. Although this sugar is employed in sweetening jellies, puddings and beverages in other lands and patronized by diabetics in this land of whom the number is increasing, it is an antiseptic but no food which the natural product is. But all the same, the German scientific skill has been able to put upon the world's market at very cheap prices a *natural* sugar also which has become a formidable rival to cane-sugar. The shining white beet sugar crystals have ingratiated themselves into the favour of our *Halvais* and confectioners. The northern provinces of India are patronizing German and Austro-



Hungarian granulated sugar in increasing quantities. The absence of response to my appeal in this country looks ominous. I once suspected whether the soul had flickered away from the heart of Indian industry. But the much needed galvanic current comes from a distance to revive and in-spirit the Indian industry. *Tropical Life*, a journal published in England, and devoted to the interests of tropical products, such as sugar-cane, cocoa, cotton, coffee, &c., in reviewing my paper on sugar industry, heads its leading article with the significant title, "Sugar Industry in India—Improved Machinery Badly Needed." Probably that is the impression which my paper created in the minds of people abroad competent to express an opinion in the matter. But I would wish very much to get an expression of Indian opinion as to whether I represented the case of the Indian sugar manufacturer correctly. But it is very distressing to find that it is very difficult to make him speak, and this will be the primary function of the Industrial Conference. The drawbacks of the industry can be learnt only from those engaged in it. Will the Indian Industrial Conference bring about a special conference of sugar-cane growers and sugar manufacturers in India at some centre where sugar manufacture is carried on on a large scale? I would prefer Allahabad. Without the co-operation of those engaged in the industry, no attempt at its improvement will succeed. The foreigners, who have thrown some capital in the sugar industry in this 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.

The future of cane-sugar industry in this country does not, however, look so hopeless. On my presentment of the case the writer in the *Tropical Life* observes as follows:—  
"This tends to show that, if properly exploited by capitalists and sugar-machinery engineers, a great deal more money could be derived from this industry than is the case at present. Out of the world's total production of 8·34 million tons of cane-sugar, India, even by means of her primitive methods, produces 3 million tons or 39 per cent. Given modern machinery, she could easily produce half as much again, if not more, without extending the area under cultivation, whilst cost per pound for manufacturing should be greatly reduced." The same paper

quotes in this connection from Mr. Nursey's lecture before the Society of Engineers to show that, with maceration and triple crushing, from 81 to 85 per cent. of juice can be obtained from the canes. Another quotation is made from the *Louisiana Planter* to show that, with the 12-roller mill, 96 per cent. of juice could be obtained, whilst if very heavy maceration or saturation of the last bagasse with water is used, even a greater percentage than 96 can be secured. "It can therefore be seen", says the writer in the *Tropical Life*, "what a tremendous margin of profit is thrown away every year, when 3 million tons of jaggery are turned out on a 50 to 60 per cent. of juice. If 75 per cent. or 85 per cent. is obtainable, at least another one million tons of sugar could be made". This is the strongest argument ever adduced in favour of employing heavy crushing machinery in the Indian sugar industry. Mr. George Osborne, writing in the *Louisiana Planter*, states that in Hawaii the demand for a high percentage extraction tends to require the 12-roller mill and the vacuum centralization system in all the large mills of the islands and that there seems to be no question of the advantage of the 12-roller mill where a large amount of work has to be done." What huge efforts are being made in other lands in procuring labour and securing facilities for the export of sugar can be gathered from the fact that Hawaii planters subscribed among themselves 300,000 dollars to cover the expenses of transporting 1,000 or more Portuguese agricultural families from the Azores to work on the sugar estates. Each family will be given an acre of land with a suitable house for abode. The Hawaiian Commercial and Sugar Company, which owns the largest cane-sugar plantation in the world, is credited with the intention of making the village of Kahului in Maui into a large seaport town. A large harbour is proposed to be constructed so that the entire sugar crop of Maui may eventually pass through it. Railway facilities from all parts of the island will be provided. An opinion is gaining ground in some quarters in this country that sugar industry can be put upon a profitable basis, with the help of simple and cheap machinery, although experience in other countries points to a different conclusion. It has been seen what efforts the small island of Hawaii is putting forth in order to place its sugar industry on a better footing. In Antigua, where a central fac-

tory was established only recently, the Central Factory Company appears to have realized a net surplus of £3,956-9s. 8d. for the year 1905. During the past few years, the establishment of central factories has gone apace. Every imaginable quarter of the globe where sugar-cane is grown is ambitious of establishing a central factory. India alone believes in the efficacy of the old method of crushing canes in small wooden mills, in the profitableness of manufacturing white sugar from jaggery, and in the adequacy of home trade for the improvement of its sugar industry. It is wrong to suppose that India is differently circumstanced from other countries. Agricultural conditions in India may differ from those of the Colonies, and probably some of the Colonial methods of obtaining canes for the factory may not be suitable for India, but the method of manufacture of sugar in central factories is the same all over the world. We, in India, have simply to copy those methods and manufacture such sugars, both raw and refined, as are marketable in any part of the world. The Government is experimenting with several varieties of cane with a view to find out the most suitable one for Indian conditions. It is for the Indian capitalists and others interested in the promotion of Indian industries to investigate where to establish factories, how to secure lands for planting canes and how to mass labour thereon. The profitable market for Indian sugar should be likewise investigated. We are better off than the Colonial manufacturers in two respects. We have got at our very doors very cheap labour for which the Colonials are paying heavily. We have an extensive home market which is gradually expanding, but which is being exploited not by us but by Germans and Austrians. The whole country should first be mapped out showing the zones of activity of foreign and native sugars, and the prices of the respective sugars at several stations in these zones. The present areas of cane cultivation and other areas which possess facilities for cane cultivation should be similarly mapped out and so also the most convenient places for the establishment of big factories by virtue of their having canal, railway, river or sea communications with the other parts of the country or the outside world. It will be a wonder to many why capital and enterprise in India should fight so shy of sugar industry when it has so quickly and unreservedly taken up cotton and jute in-

dustries on a large scale, employing the most modern machinery in manufacture and has exploited the distant markets. The reason is not that raw material for the cotton and jute industries can be had in more plentiful abundance in the country than for the sugar industry. The average annual estimated production of cotton and jute in India is about 480,000 and 950,000 tons, respectively, in round figures, while that of raw cane sugar is three million tons. This last estimate is only on a 50 to 60 per cent. basis, but if 96 per cent. could be extracted by means of modern appliances, the figure would mount up to 5 million tons at least, without increasing the present acreage of cultivation even by a single acre. If larger markets for Indian sugar could be secured outside, with Government's providing for more irrigational facilities, another million acres will come under the plough producing in all about 7 or 8 million tons of cane-sugar or nearly one and a half times the quantity which the whole world, except India, now produces. The only reason that occurs to me is the difficulty of concentration at the factories of a large quantity of canes representing 3 million tons of raw sugar and passing the whole quantity through the mills within a short cane season of 3 or 4 months. Cane has to pass through the mills within 24 hours of cutting and cannot be stored up and worked leisurely like cotton and jute. It is a fact well known that sugar factories, however big they may be, have to be idle for a greater part of the year. Another reason is that, according to one great authority, who speaks from recorded results, sugar production runs in a four-yearly cycle. In one year, the crop will be very large, and the demand of the country considerably over supplied; there is consequently a very heavy fall in prices. In the second year there will be a fair crop, as, although no new cane will have been planted, there will be a large return from re-growth of last year's ratoons. Internal prices may somewhat improve, but on the whole, they will not prove remunerative. In the third year there will be a small crop, perhaps barely sufficient, for internal consumption. Prices will then improve greatly, and in consequence the planter will again begin to plant on a large scale, so that, in the fourth year, there will be a return once more to a large crop and low prices. This was written of Brazil, but the conditions of sugar industry in that

country are so similar to those in India that those remarks may equally apply to the latter country. The sugar industry in Brazil is said to be heavily handicapped by excessive taxation, deficient means of transport, lack of capital, high rates of interest, and heavy railway freights. Some at least of these features may be found in India. As regards railway freights, the *Tropical Life*, commenting upon my paper, observes as follows:—

“At present the cost of railway carriage either to convey the sugar to the consuming centres, or to transport the coal and machinery to the sugar factory, is a serious drawback in the development of the industry, and handicaps the sale of the sugar in competition with the imported article. With a little organisation in the bulking of freightage, this difficulty could easily be overcome, as it is in Europe with vegetables, poultry, etc., produced in very small lots, but brought to a common centre, and despatched in train loads at a time. Even in England, which is not always up-to-date in these matters, when the fruit trains are being despatched, we are told the produce is brought to the station in vehicles of every description, “from a heavy dray to a sugar-box on wheels.” If this can be done in Europe with such crops, it should surely be possible to do it in India with an article like sugar, produced in fairly large quantities”.

This is a big subject which requires patient investigation with reference to the special conditions of this country, and I do not like to dogmatise from a knowledge of the conditions of manufacture in other countries. But one thing I would say. If we wish to improve our sugar industry, we must have an eye to the export trade in raw sugar at least. If that position is granted, then, the raw sugar that we produce must be of the same form and of the same standard as those produced in the Colonies, otherwise it is impossible to secure markets for them in Europe and America. Such sugar can be produced in big factories alone. To run big factories, there should be plentiful supply of canes near at hand. To secure it, for the present at least, the plantations should be owned by the factories or they should be under the effective control and direction of factory owners. The plantations should be financed by the factory owners. These methods should be

adopted until the agricultural classes learn the advantages of some of the Colonial tenures. It goes without saying that, to run the industry on these lines, large capital is required. I do by no means despise cheaper methods which are constantly being advocated for acceptance by the sugar-cane growing ryots. They deserve a trial also but nothing should be accepted on authority. When the crash comes, the country's progress will be thrown back by several years. At present people are embarking upon enterprises having for their object the improvement of industries in India. Of course, next to cotton, sugar industry merits our immediate attention, and we also see some activity in this direction. The promoters require advice and support which no body is in a better position to give than the Indian Industrial Conference, whose duty it will be to procure the best advice from unexceptionable sources.

## INDIAN SUGAR DEVELOPMENT.

MR. A. E. JORDAN, A.M.I.M.E., F.S.A.,

*Messrs. Martin & Co., Calcutta.*

—:o!—

ALTHOUGH the development of the Indian Sugar Industry is a matter of the utmost importance to the country, I have no desire to burden you with a very lengthy paper on the subject. As a matter of fact, I have written so much on the sugar industry, during the last two years especially without any appreciable results beyond arousing some interest where before there was none, that I fear, a very lengthy paper would at this time be a burden to myself even, keenly interested as I am in the subject, because it could only be a repetition of what I have written so often.

I will therefore be content, as you no doubt will be also, if I simply state a few facts regarding the backward state of the sugar industry in this country and make one or two suggestions for improving it. The sugar manufactured in this country is derived from two sources, viz. the sugar-cane and the palm tree. The area under sugar-cane cultivation is anything from 3 to 5 million acres, and it is most difficult to form an estimate of the outturn of raw sugar, but if we take the cultivation at 3 million acres only, and reckon on an average of 20 tons of cane per acre, the output of raw sugar should be something like 6 million tons.

The method of manufacturing this raw sugar, as carried out by the cultivators, must be known, I am sure, to everyone, and is simply this.

The canes are crushed by country cattle mills, which extract only about 50 per cent. of the juice which is in the cane, and this juice is boiled into "gur" or "jaggery," which frequently yields less than 50 per cent. sugar.

You can see some of this raw sugar in the Agricultural Section of the Exhibition. It looks innocent enough in all conscience, but it is the manufacture of this very article which is at the bottom of the deplorable backward state of the sugar industry of this country for the following reasons:—

In the first place, through inefficient crushing of the canes, the cultivator does not obtain the profit from his crop which he ought to obtain, and the quality of the raw sugar which turns out by his crude methods of boiling, is in most cases, so poor that is to say, it yields such a low percentage of sugar when refined, that it can only fetch a low price, so the cultivator has absolutely no encouragement to extend his sugar-cane cultivation.

In order to make white sugar, this raw sugar must be made into a liquor for filtering, and as the liquor must be decolorised being of a dirty brown colour caused by the method of boiling it, it is absolutely necessary that it be passed through some medium which will decolorise it to make white sugar, and the only medium that will effect this is animal char. Burnt bones possess the necessary chemical or mechanical, whichever you like to call it, properties of effecting this decolorisation of the liquid as nothing else does, but I may here state for the benefit of those who imagine that bones and blood are used in the manufacture of sugar, that when refining the raw sugar the liquor simply filters through the animal char, and is not mixed in any way with it, and neither is there any blood used in the manufacture of sugar in this country or in any country exporting sugar to India. The use of animal char, too, as regards the white sugar consumed in this country is confined to Indian refineries only, and simply on account of the manufacture of raw sugar by the people themselves, notwithstanding the fact that they object to the use of animal char although there is no other means of making the raw sugar, white.

The countries exporting sugar to India do not make raw sugar at all, but manufacture the white sugar straight from the cane juice and the beet juice by the sulphurous acid gas process, and without the use of animal char.

The losses incurred in the refining of raw sugar are enormous as in order to keep the refinery working throughout the year the raw material has to be stored, deterioration takes place, and on refining, frequently considerably over 50 per cent. comes out as uncrystallisable or grape sugar, what is commonly known as molasses.

It is this molasses, which when converted into spirit, brings to the Government such a large annual revenue, and I believe it



to be the case that the Madras Government, on the one hand does everything in its power to extend the cultivation of the sugar-cane by establishing experimental farms and pumping plants for irrigation, while on the other hand, unknowingly, it encourages the conversion of the sugar into spirit by playing higher rates for the spirit made from raw sugar only, than for the spirit which is made from molasses only.

The Member of Council who asked the question "Will the Government state what steps are being taken to check the alarming increase in the consumption of intoxicants in Bengal, as shewn in the Report of the Commissioner of Excise for 1905-06" at the meeting of the Bengal Legislative Council on the 15th instant, might now know of a way to check the consumption of intoxicants, *viz.*, by encouraging sugar manufacture instead.

In the Madras Presidency, there are proprietors of sugar refineries, who make the manufacture of spirit to fulfil the Government contracts their chief business and purchase jaggery for the sole purpose of converting it into spirit, notwithstanding the fact that sugar is much more valuable in its proper form than when converted into material for the fermenting house (I do not refer to the East India Distilleries which use for the refuse molasses). One of those proprietors has a refinery which has been closed for the past three years, and he was quite unaware of the fact that sugar could be made straight for the cause which grow in abundance round his concern until I told him so.

He nevertheless still lacks confidence through past failures, and, instead of purchasing the necessary cane crushing and juice evaporating plant himself, he is looking out for some one else to do so.

There are thousands of people, both Europeans and Indians of the same wrong opinion, that, before white sugar can be made, raw sugar has first to be made, and, unfortunately, the Agricultural Departments have been of the same wrong opinion. The Agricultural Department of the United Provinces, however, have recently been making some experiments in making sugar direct from the juice, but while the apparatus used by Mr. Hadi, which consists simply of several pans placed over a fire, the most important feature being the treatment of the juice with "dhaula" stalks and

"kita" or soapnut for clarifying and bleaching, is useful enough for demonstration purposes, this method will have to be considerably improved to make sugar manufacture commercially successful which, of course, is necessary before any development can take place, and this can only be done as has already been found in other countries by employing steam plant.

The United Provinces Agricultural Department have evidently recognised this also as it demonstrates the driving of the centrifugal machines by a steam engine, and it would have been to great advantage as Mr. Hadi himself sees if a steam driven mill had also been obtained to do the work of the numerous cattle mills which are demonstrating in the best way possible how the juice can be left unexpressed from the canes. It follows, therefore, that if steam is necessary for the centrifugals and mills, it is also necessary for economising in fuel consumption and for boiling the juice whereby a higher output and a better quality of sugar is obtained.

It will no doubt be very many years before there are sufficient factories in the country to deal with the cane cultivation, and raw sugar will continue to be made by many cultivators, but as this raw sugar cannot be made into white sugar without the employment of animal char, then, it should be converted in a high class yellow sugar instead, which does not require the use of animal char, by using the most up-to-date machinery whereby the maximum amount of sugar and the minimum of molasses will be obtained from it. We must remember also that, in dealing with the raw sugar, fuel has to be purchased to work the refinery.

We have been told by the agricultural chemist to the Mysore Government, in this fifth annual report that it should be the object of the cultivators to turn out a better quality of raw sugar for the refinery by using the centrifugal machine and extracting the molasses, but in making this statement he could not have given the consideration to the subject which it requires.

When the cultivator has once made the raw sugar the enormous losses have occurred, and no subsequent treatment will recover the quantity of sugar left unexpressed from the canes, or the quantity which has been converted into molasses in boiling. Even if put through the centrifugal machine, the

high quality of raw sugar left in the basket would fetch such a high price, it would find a most profitable market in that state and the refineries which attempted to purchase and work it, would be obliged to do exactly as they did in the United Kingdom and that is, close, as they would not possibly compete with the imported sugar.

If the refinery refining the "gur" has a distillery attached, then it is manufacture of spirit from the molasses which enables it to keep open, and that it is exactly what takes place in this country.

In Mysore there is such a concern, while canes of the best variety in the world containing, according to analysis made, as high as 21 per cent. "sucrose" and only a half per cent. "glucose," are grown. The same thing happens in every part of India, the canes are grown, half the sugar is burnt, and a considerable portion is turned into spirit.

Let us see what is done in the countries which dump the sugar into India.

The canes are crushed by powerful triple crushing plants, not one three roller mill, but three roller mills in succession, 90 per cent. and even more, of the juice in the cane is expressed, but instead of this juice being boiled into a raw sugar it is made into sugar straight away, over 90 per cent. of the crystallised sugar being obtained by employing the following methods.

The juice as it leaves the mills is immediately bleached by mixing with sulphurous acid gas, obtained by burning sulphur in a small furnace, and after bleaching, any acidity of the juice is immediately neutralised by the application of lime in the form of milk of lime, in order to prevent as far as possible the formation of "glucose," i. e., molasses, which is caused only by the acidity of the juice.

After liming, the filtering of the juice through cloth bags, the evaporation to a thick liquor, the boiling to grain in the vacuum pan, and the spinning of the wet sugar in the centrifugals, are all carried out by the most up-to-date and economical machinery, and in this way the maximum amount of sugar and the minimum of molasses is turned out by employing the crushed cane only, which goes straight from the mills to the furnaces, as fuel.

This is white sugar made without animal char filtration which is unnecessary as the cane juice is of a clear opaque colour, quite different to the dirty brown good liquor.

That is how the cane-sugar and beet-sugar imported into this country is made and is the method that must be adopted in India also.

It is useless for the poor cultivator to attempt manufacturing sugar, as he has neither the knowledge nor the money required. What is wanted is co-operation on the joint-stock system in order to obtain the necessary capital to purchase the plant. In numerous villages throughout the country, where the canes are crushed independently by the cultivators, small steam plants should be established to deal with from 50 to 100 acres per season at a cost of about Rs. 16,500 without a vacuum pan which would cost another Rs. 5,500, say, to which the cultivators would send their canes. They would thus be freed from the cares and anxieties incidental to the manufacture and sale of the product, and they would be able to give more attention to improving the cultivation which would undoubtedly rapidly extend.

The small steam plants to run out from 1 to 2 tons of sugar per day instead of making raw sugar, would make pure white cane-sugar, thus avoiding the losses, and the sugar would be of a better quality than the Benares sugar now sold in Calcutta at Rs. 11 per maund of 80 lbs.

These steam plants would be extended also to suit the extension of cultivation and in time there would be large cane sugar factories where these small ones existed, and probably not a pound of sugar would be imported. From the enquiries which I have received from all parts of the country where the sugar-cane is grown, I am as certain that that is what will take place, as I am that this paper is being read to-day.

It may be said that these factories would only work during the cane seasons. Well, such is the case in other countries which have to import Indian labour, rice, cattle, etc., and have disadvantages such as cyclones and cattle disease to contend against and yet profits are made by sending their product to India. But the cane sugar factory in this country might also be a combination of factory and refinery, making white sugar from the canes grown in its vicinity and yellow crystals from the "gur"

made by the cultivators in outlying districts, and so would be able to work all the year round. The Baroda State Factory, which I inspected some time ago, was intended to work on these lines, with animal char plant, however, but owing to not having the necessary machinery to obtain a high extraction of juice when the price of the canes was high, owing to incompetent management, and the fact that the jaggery was brought up from the south of India in boats and converted itself into molasses on the way, although thousands of tons of Palm Tree Jaggery was available at comparatively easy distance, it was a failure, as it could only be. So much for the sugar cane.

The other source of sugar manufacture is the Date or Palmyra Tree already mentioned. There is such a large business done around Calcutta in the former, and in the Tinnevely District of the Madras Presidency in the latter.

Exactly the same thing is done with the juice from these trees when it is collected, as is done with the sugar-cane juice. It is boiled to "Gur."

The same remedy as I have suggested with regard to the raw cane sugar should be adopted here also, that is, for the Date Tree good to be made into a high class yellow sugar which does not require the use of animal char in its manufacture. I would mention here, however, that the sugar turned out by the Calcutta and Madras Refineries, and which is made by employing animal char, finds a ready market in the country and I wonder after all if the objection to animal char is not only an imaginary one.

To manufacture the white sugar direct from the juice as it is collected from the trees a difficulty is met with which does not apply to sugar-cane. I mean the difficulty of getting the juice in large quantities to the plant, for while the canes can easily be conveyed by carts, the juice from the trees collected in small pots is not so easily handled. There is one way out of this difficulty, however, for in Queensland and elsewhere the juice is sometimes conveyed long distances from the cane crushing mills to the sugar making plant, and an attempt should certainly be made to avoid the enormous losses in sugar by manufacturing from the juice direct.

I would therefore suggest that small steam plants similar to those I have recommended for the sugar-cane centres, but

without the cane crushing mill while there is no cane cultivation, be established in the centres of the Date Tree Cultivation.

The pots of juice when taken from the trees could be emptied into a tank, and treated immediately with milk of lime in order to neutralise the acidity thus preventing the fermentation and the consequent formation of molasses.

These tanks of juice containing say 300 gallons each could easily collect the juice from a circle of several thousands of trees, and be conveyed to the plant for manufacturing into white sugar straight away.

The cost of such a plant to turn out  $\frac{1}{2}$  to 1 ton of sugar per day would be about Rs. 6,000, and the sugar would have a value of Rs. 6 per maund at any rate.

The question is, who is to do this, for like the cane cultivators, the men who collect the juice have not the knowledge or capital, so it must be done on the Joint Stock System.

We are told in another paper on the subject that there are millions of Date Trees growing wild in Central India, and there are millions of such trees growing wild in the forests of the Nizam's Dominions and other parts of India also of which no use is made, and I am confident that if such small plants were established to manufacture sugar direct from the Sugar Cane and Palm Tree Juice, the Indian Sugar Industry would be revolutionised.

I have often been told that my writings and figures in the various Indian Journals have aroused some interest in the matter and I have been inundated with letters of enquiry from all parts regarding sugar machinery for making white sugar from "Gur" but when I informed my correspondents that animal char was necessary, I heard no more from them.

I understand that in some quarters the Government is blamed for the large annual imports of sugar which have a value of seven crores of rupees but the only blame that can be attached to Government is in not obtaining experts in the manufacture of sugar as well as experts in cultivation, for to my mind, showing how the enormous wastage of sugar in the country could be avoided, and how greater profits could be obtained from the present crops, is of much more importance than showing the cultivators how to grow the cane and convert the sugar into a material only fit for the distillery, for that is

exactly what the demonstrations of "Gur" manufacture amount to, and what the cultivators know only too well how to do, without being taught.

In the Punjab, and even in Calcutta, the boycotting of imported sugar has taken place, but the boycotting of sugar is only an expression of the people's impotency regarding sugar manufacture, and no amount of boycotting will help the development of Indian sugar.

If there is any desire to develop what would be the foremost agricultural industry of the country, and to have the indigenous product take the place of the imported one, then sugar must be made as elsewhere, in the most economical manner possible, and without employing any material that will make its consumption obnoxious to the people.

To facilitate the formation of Companies for the purpose of erecting Sugar Factories, I attach to this paper some figures showing what profits may be expected and in view of the profits made by the Cawnpur Sugar Works, Limited, I think my figures are extremely moderate.

In conclusion, I would anticipate the question "How are we to work such plants when we have no knowledge of the work"? by saying, that my firm Messrs. Martin & Co., Calcutta, who have now taken up sugar work in earnest, will be only too glad to give all the necessary expert advice and assistance to any who wish to take up sugar manufacture.

*Balance Sheet of a Sugar Factory to turn out 6 tons of sugar per 24 hours from sugarcane during the cane season, and from raw sugar in the off season, without animal char.*

Factory to deal with 50 tons of cane (2 acres) in 24 hours = 5,000 tons of cane per season of 100 days (200 acres) 18" x 30". Two Roller Mill extracts 400 galls. juice per hour = 9,600 galls. per day = @ 1,650 galls. juice per ton of sugar = 6 tons of all sugar = 600 tons per 100 days.

<i>Cane Season of 100 days :—</i>		Rs.
300 tons (60 <sup>o</sup> / <sub>o</sub> ) 1st sugar @ Rs. 6-8 per md.		65,520
120 " (20 <sup>o</sup> / <sub>o</sub> ) 2nd " @ Rs. 5 "		16,800
120 " (20 <sup>o</sup> / <sub>o</sub> ) Molasses Gur @ Rs. 2 per md.		6,720
<hr/>	600 tons	<hr/>

<i>Gur Season of 200 days :—</i>		Rs.
600 tons (50 <sup>o</sup> / <sub>o</sub> ) yellow sugar @ Rs. 6 per md.		100,800
240 " (20 <sup>o</sup> / <sub>o</sub> ) 2nd sugars @ Rs. 5 "		33,600
300 " (30 <sup>o</sup> / <sub>o</sub> ) Molasses Gur @ Rs. 2 per md.		20,160
<hr/>	1,200	<hr/>
		2,43,600

	Rs.
5,000 tons cane @ 5 annas per maund ...	43,750
1,200 tons Gur @ Rs. 3/8 " " ...	1,17,600
Cost of manufacture @ Rs. 20 per ton of produce ...	36,000
Fuel for Gur Season ...	12,000
Depreciation of Buildings and Machinery @ Rs. 10 ...	8,000
Nett Profit ...	26,250
	<hr/>
	2,43,600

	Rs.
Declares 26 <sup>o</sup> / <sub>o</sub> dividend on 1 lakh	
CAPITAL.   Machinery on spot ..	60,000
Erection of Buildings and Machinery ..	20,000
Working Capital ..	20,000
	<hr/>
	1,00,000



## **CHROME TANNING.**

**MR. ALFRED CHATTERTON,**

*Superintendent, School of Arts, Madras.*

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HIDES and skins, either in their raw condition or lightly tanned, form important items in the export trade of India. Fluctuating from year to year and dependent to some extent upon the character of the season, they have for some years past averaged about 9 crores of rupees in value, but last year stimulated by the high prices obtainable in Europe and America, the value of the trade rose to nearly 14 crores of rupees and in the list of Indian exports arranged in the order of their importance they have now reached the fourth place. The great bulk of the trade is done in the raw material and is mainly from the three Presidency ports of Calcutta, Bombay and Madras. The Calcutta trade is entirely in raw hides and skins, the Bombay trade includes a considerable percentage of tanned hides and skins, whilst in Madras only tanned hides are exported and in the skin trade nearly two-thirds of the value of the exports are in the tanned condition. Up to the year 1898 the export of raw material from Madras was non-existent, and although now in the skin trade it amounts to nearly 40 per cent., it has not grown so rapidly as was anticipated some four or five years ago.

The demand for leather throughout the world seems to be rapidly increasing, and being in excess of the supply, prices have had an upward tendency for many years past. Excluding the great stock-raising countries, such as the Australian Commonwealth and the Argentine Republic, India is one of the few countries which, on account of its poverty, is still able to export a very large proportion of the hides and skins which it produces. The external trade has risen to nearly 14 crores of rupees, but it is impossible to even roughly estimate the value of the internal consumption. Possibly its value is as great or greater than that of the external trade, and there is evidence that it is steadily rising. Indian skins are of good quality, but, with few exceptions, the hides are inferior and it is impossible to obtain a first-class manufactured product from them.

Cawnpore is the centre of the modern leather trade, and Bombay, on a smaller scale, produces leather in no way inferior. This industry has grown up under the stimulus of demands from the Military Department, and its flourishing condition to-day is due not only to the expansion of military requirements but also to indents from other Government departments which in the aggregate require considerable supplies of leather goods. In recent years a considerable internal demand has grown up for cheap machine-made boots and shoes and it is probable that the Swadeshi movement, especially in Bengal, has benefited local manufacturers of such goods. Excluding boots and shoes, the value of which is not given separately, the trade returns show that from 25 to 30 lakhs of rupees worth of leather or leather goods are imported into India yearly. The bulk of this trade is probably in dressed skins for book-binding and upholstery work, in high class leather for belting and machinery and to some extent in fancy leather goods. It is hardly probable that the whole of this not inconsiderable import business could be captured by native manufacturers, but there is absolutely no reason, except want of enterprise on the part of the manufacturers, why India should not produce dressed skins equal in quality to any made in Europe and America.

The bulk of the leather consumed in the country is very poor stuff and the methods of tanning are so crude that vast quantities of fairly good hides are converted into most inferior leather. The inefficiency of the indigenous tannery is notorious and in the aggregate the annual waste of material amounts to a sum which can only be estimated in crores of rupees. Boots and shoes, sandals, harness, mussocks, paccali bags and bags for lifting water from wells for irrigation are among the chief articles for which the inferior country leather is in large demand. No information is available regarding this native business. The village chuckler was both tanner and leather worker, but in the South of India at any rate, the numerous tanneries which have sprung up for dealing with the surplus hides and skins available for the export trade, have also secured a good deal of his business as a tanner. Yet he is by no means extinct, and the enormous increase in the export trade of the last two years indicates the probability that there is still

a good deal of valuable material to be rescued from his primitive methods of treatment.

In one direction, due to the increase in the number of wells used for irrigation from which the water is drawn by mhotes, there has certainly been a considerable expansion in the local demand for leather. All over India the mhote or charsa is a familiar object and every year millions of good hides are converted into bad leather for these water-lifting appliances. The material is not altogether suited for the work and in constant use water bags have but a comparatively short life. If anything could be done to improve the quality of the leather and render it more durable, it would be conferring a very substantial boon upon the ryot and in proportion to the improvement there would be set free a corresponding number of hides for export. The increasing demand for leather in India is due to the improvement in the condition of the people and sooner or later it will affect the export trade unless in the meantime the available supplies of raw material are treated with greater respect and converted into better and more durable leather than at present. The main object of the present paper is to describe what is being done in Madras to bring about this very desirable result.

The mhote in good working order and with a water bag the capacity of which is properly proportioned to the weight of the bullocks is an extremely efficient method of lifting water when only animal power can be employed, but the normal condition of the ryot's mhote is far from satisfactory as the bag soon becomes brittle and tears and the rents are badly patched so that fully a third of the water which is lifted from the well falls back into it before the bag is emptied.---In the matter of repairs the ryot is entirely in the hands of the village chuckler and if he can be supplied with a better material than the common country leather, there is but little doubt that as soon as he becomes practically acquainted with its advantages, he will readily adopt it even though it costs considerably more. In the South of India the piccotah with an iron bucket is almost universally employed in the Coast Districts where the water-bearing sands are not more than 12 or 15 feet from the surface and not a few mhotes, in use in brick wells, are of composite construction, sheet iron being used for the bag

and leather only for the trunk. With care such whotes are satisfactory, but they are easily damaged and difficult to repair. In many districts, the irrigation wells are large holes sunk into the rock and in practice it has been found that the leather bag is superior to the iron bucket, as the latter is so easily damaged against the rocky sides. Moreover, they must be very thin or else the weight becomes excessive and when very thin they require carefully looking after or they rapidly rust through. From time to time experiments have been made with various substitutes for leather, but nothing seems to have caught on and it remains, therefore, to improve the quality of the leather till a more satisfactory substitute for it can be found.

With these facts very forcibly impressed upon me whilst conducting a series of experiments on various types of water-lift in Southern India, it was only natural, when I learnt of chrome leather and the very slight action which water has upon it, to experiment with it and ascertain whether it was feasible or not to manufacture the leather in the country. The practical tanners of Madras whom I consulted in the matter were unanimously of opinion that owing to the climate chrome tanning would be a failure. They had made experiments themselves and their experiments led to nothing because their object in view was to produce a material suitable for export. That was not the way I looked at the matter at all, and it seemed to me that though it might be impracticable to manufacture chrome leather or glacé kid which would find a market in Europe or America, yet it might be possible to produce in India chrome leather suited to Indian requirements. Accordingly, the Government of Madras were addressed on the subject and a sum of Rs. 2,000 was placed at my disposal for experiments on the lines which I indicated, the main object being to produce a chrome tanned leather suitable for use in well irrigation. Neither I nor my assistant, Mr. Brand, who was mainly in charge of the experiments during their initial stages, had any previous knowledge of leather manufacture and naturally we began working on a small scale, tried many experiments and met with not a few failures, but ultimately we were able to demonstrate the practicability of the original idea. That was probably the easiest part of the work as we were able to obtain much assistance from such books as Procter's "Principles of

Leather Manufacture" and in working out the local Indian problem the Secretary of State for India permitted us to enlist the services of a first-class English expert.

The first stage has been successfully passed, and we are now engaged in the more difficult matter of persuading the people of this country to give Indian chrome leather a fair trial. We can manufacture chrome leather good enough for most purposes, and the experience of the last two years has shown that the original anticipations of its superiority have been fully justified. The price list of our manufactures, which we have issued recently, contains a large number of favourable testimonials from people who have used it, but still the demand for chrome leather is small when compared with the enormous consumption of leather and only very slowly do sales increase. Nevertheless, we are making progress and have now some sort of assurance that ultimately the chrome processes of manufacture will supersede the crude and wasteful methods of the chuckler.

Many hundreds of water buckets have been manufactured and brought into use in all parts of India and the general consensus of opinion of those who have used them is that the material is in every way superior to ordinary country leather and the life of a bucket very much longer. It is difficult to say what is the relative durability of the two kinds of leather on account of the variations in quality of the hides, but it may be safely assumed that chrome leather made from good hides is at least twice as durable as the best country tanned leather. As will be seen later on there is no great difference in the cost of manufacturing leather by the two processes, though naturally in an experimental tannery, like that attached to the School of Arts in Madras, where the work can only be carried on on a comparatively small scale, the cost of making chrome leather is much heavier than it would be in a large tannery doing a big trade. If we made bark tanned leather under similar conditions, the cost of doing so would be much greater than it is in an ordinary native tannery.

Having produced chrome leather suitable for water bags, or kavalais as they are locally known, it was natural to experiment with the leather in other directions and boots and shoes, sandals, harness and a great variety of miscel-

laneous articles have been made from it. The natural colour of the leather is a pale lavender blue which is almost white when the leather is made in weak solutions. The colour is not at all displeasing and a good deal of it is worked up in the undyed condition, especially for harness in Madras. Usually, however, after the leather is tanned it has to be dyed, which can readily be done and black leather and several shades of brown leather are regularly manufactured. Experiments also have been made in tanning skins and preparing glacé kid and though it must be confessed that our productions are not equal in finish to those imported, they have proved serviceable enough and being much cheaper have found a fairly ready sale. So far our work has been done on a small scale and almost entirely without the aid of machinery, but the Government of Madras have recently sanctioned the opening of a new tannery in the neighbourhood of Madras in which the manufacture of leather on a much larger scale will be possible. The plans for the new tannery have been prepared and include the installation of a fairly complete set of modern leather-dressing machinery. It will then be possible to do much better work and ultimately we hope to be able to materially displace the leather now imported from Europe and America.

*Characteristics of Chrome Leather.*—I do not propose to discuss these at any length, but it may be well to briefly draw attention to some of the more important points in which it differs from ordinary leather. In the first place, from a given weight of hide substance, the weight of chrome leather produced is considerably less than when it is converted into bark tanned leather. In the chrome process the hide substance is acted upon by the chemicals in the tanning bath, but very little additional weight is gained by absorption, whereas, as is well known, a very marked increase in weight is obtained when the ordinary bark tanning processes are properly conducted. From ten pounds of flint dry hide the average weight of bark tanned leather produced is nearly ten lbs., but the weight of chrome leather will be not more than  $7\frac{1}{2}$  lbs. The ratio is roughly three-fourths. It, therefore, follows that buying chrome leather by the pound the price will always be at least 33 per cent. more than that of bark tanned leather. Chrome tanned leather is stronger than bark tanned leather, so much so that the loss in weight

and decrease in sectional area is actually accompanied by an increase in the strength. Its chief physical characteristic is its extreme softness, which renders it very suitable for boot and shoe uppers. In many cases, however, stiffness is distinctly desirable, and such articles as solid leather bags and trunks are much better made of ordinary leather. Chrome tanned leather, unless very carefully manufactured, tends to stretch considerably more than bark tanned leather, and that for certain kinds of work has been counted a serious disadvantage, especially when it has to be employed for military equipment. With care it is, however, possible to manufacture chrome leather which possesses no more stretch than ordinary leather and which at the same time has a considerably greater tensile strength. Harness made from the leather turned out in Madras has proved perfectly satisfactory, and large quantities of belting are in use where centrifugal pumps driven by oil-engines are lifting water for irrigation. This is very trying work for belting, and though we have not yet succeeded in producing an absolutely satisfactory chrome leather belt, yet those made in Madras are able to hold their own in price and durability when compared with the belts formerly used.

In the manufacture of sole leather the chrome process yields a material which is extremely durable, and it has been employed in making up thousands of pairs of boots and sandals. The leather is sufficiently soft to make it comfortable to the feet, and it possesses a power of resisting abrasion which has never been approached by the very best English sole leather. For boots and shoes it possesses one serious disadvantage due to the fact that, when wet, the surface becomes slippery and it is not altogether safe to walk about on chrome tanned soles in cities which are paved with asphalt or stone flags. This is a matter of no importance in India where pavements are almost non-existent, and the general suitability of chrome leather for both soles and uppers is attested by the popularity of Madras chrome leather boots among the planters of India. Thanks to the parcel post system, the planters of Assam and of remote stations in the Himalayas are able to get boots and shoes from Madras as easily and as cheaply as from Cawnpore or Calcutta.

The final property of chrome leather to which I wish to draw attention is its peculiar behaviour when wetted. Ordinary

leather when wetted and dried becomes hard and stiff, and if soaked in water for any length of time, the water becomes turbid, due to the solution of some of the constituents of the leather. On the other hand, chrome leather, when wetted and dried, remains quite soft and prolonged immersion in water has no effect upon it. If ordinary leather be boiled, in a few minutes it is practically destroyed, whereas very little harm is done in the same time to chrome leather. Chrome leather is in no sense waterproof, but for practical purposes it is unaffected by water and is consequently *par excellence* the material best suited for exposure to the action of moisture. It is this property that led us to take it up in the first instance for water bags and it is that which renders it so popular among people who live in damp climates. Ordinary leather to be kept in good condition must be treated with dressings of some kind or other from time to time and, although these preparations may be used for chrome leather, they are not needed to anything like the same extent and neglect to employ them does very little harm.

*Methods of chrome tanning employed in Madras.*—Three years ago, under the orders of the Government of India, a Monograph on Tanning and Working in Leather was specially prepared in each Province of India, and those who are desirous of information regarding native methods of tanning will do well to consult these papers. They can be obtained from any of the Agents for the sale of Government publications, but so rapid has been the change during the last two or three years in the conditions under which the export trade is carried on, that they are no longer reliable guides as to the commercial aspects of tanning.

In an addendum to the Madras Monograph a brief account of the earlier experiments in chrome tanning is given and in the remainder of this paper I propose to amplify that note and describe in some detail the actual methods of working employed in the Chrome Leather Department, so that any one who wishes to start this industry or to carry on similar experiments may be able to obtain full information regarding our work in Madras.

*Hides and skins.*—The purchase of suitable raw material has proved to be one of the greatest difficulties we have had to contend with, as not only at the outset were we inexperienced in regard to the methods of the trade, but we had little or no knowledge as to what was best suited for the chrome tanning



process. There are a considerable number of tanneries in the neighbourhood of Madras, but they mainly deal with coast hides or Calcutta rejections and it is practically impossible to get suitable hides from them. We soon found that satisfactory chrome leather could only be produced from good hides and latterly for light hides we rely almost entirely upon those which can be obtained from the Madras slaughter-houses. For a heavier class of hide, the best of which are good enough for harness leather, we mainly rely upon the supply of Nellore cow hides of which hitherto we have been able to get as many as we wanted at very reasonable prices. For water bags, or kavalais as they are locally called, we found light cow hides unsatisfactory and expensive, and, unless specially ordered otherwise, we invariably employ light buffs which are usually free from brands and are fairly cheap. There is a very considerable demand for chrome-tanned sole leather which has to be made from hides much heavier than those usually obtainable in the local market and we have had some difficulty in getting a sufficient quantity. Buffalo hides are invariably used and in the wet salted condition they may weigh from 50 to 100 lbs. depending upon the extent of the spread. One fairly large consignment of hides from Rangoon proved extremely satisfactory in regard to price, but in the absence of machinery for splitting the hides we found many of them too thick and they could only be worked up by incurring a heavy loss in shaving the leather down to the suitable thickness. Latterly we have purchased dry salted and arsenically cured hides in the Calcutta market and have found them fairly satisfactory. The demand for our sole leather enables us now to make fairly large purchases at a time, and we have less difficulty as the business we can offer is becoming worth the while of those in the trade to take up. Good calf skins we have found it almost impossible to procure, but there has been no difficulty in the matter of goat and sheep skins.

It may here be convenient to mention that we have a very considerable business in tanning skins of wild animals such as those of the tiger, panther, bear and various kinds of deer with the hair on and the results are extremely satisfactory if the skins reach us in good condition. The hair is unaffected by the chrome liquor and the skins when finished possess all the quali-

ties of a good chrome leather. In a similar way we have tanned a good many crocodile hides and a large number of snake skins the latter being in great demand for the manufacture of fancy articles, especially ladies' waist belts. In their natural colour they look very well and can be readily dyed to any required shade. Snake skins are very plentiful in India, but so far as I know this is the first attempt that has ever been made to turn them to practical account. To obtain good results, the skins must not be damaged and special care has to be taken in killing the snakes.

*Processes preliminary to tanning.*—These differ very little from those ordinarily practised in native tanneries, but if good results are to be obtained, it is necessary to exercise the greatest possible care at each stage. The first step is to get the hides back into their natural condition and free from blood and dirt. The dried hides require soaking in water for about 24 hours and when quite soft should be washed in several changes of water. The green and wet salted hides merely require to be thoroughly washed, and they are then in a fit condition to be put in the lime pits. Owing to the fact that we are not allowed to establish lime pits on the premises of the School of Arts, this work has to be done outside the Madras Municipal limits in a native tannery and great difficulty has been experienced in getting native tanners to do the work properly. The pits are worked in a series of four, the first pit containing the oldest lime and the last pit containing the fresh lime. The hides pass through the series of pits remaining in each pit about  $2\frac{1}{2}$  days, so that the whole liming process lasts about 10 days. The operations of unhairing, fleshing and scudding need not be described here in detail as there is nothing novel about them. It is most important that whilst the hides should be well plumped up or swollen by the action of the lime, this should not be continued long enough to allow of the lime dissolving any appreciable quantity of the hide substance. If this is not carefully attended to, the final leather will certainly be unsatisfactory. In the manufacture of good sole leather this is of the greatest possible importance, and latterly we have considerably shortened liming process by the use of sulphide of sodium. The process adopted is as follows :—

About one pound of sodium sulphide is dissolved in as small a quantity of water as possible and to the solution from 6 to 8 lbs.

of freshly slaked shell lime is added and the mixture thoroughly stirred. More water is then added to bring it to the consistency of a thick cream. This mixture is allowed to stand for about 3 hours and is then spread over the flesh side of the hides to be unhaired, after which they are folded up and kept in a cool moist place for about 24 hours, when the hair will be found to be sufficiently loosened to be removed in the ordinary way.

After unhairing the hides are washed in water and put into a tub of fresh lime where in 24 hours they are sufficiently plumped and ready for further treatment. After scudding it is necessary to remove, as far as possible, all traces of lime from the hides, and to this end, they are thoroughly washed in water and well trodded over by the coolies. The last traces of lime are removed by means of lactic acid of which a solution containing  $\frac{3}{4}$  per cent. is employed. After being put in the solution, the hides rapidly lose their plumpness and become very slippery to the touch. To test whether the last traces of lime are removed or not, a small piece is cut out of the thickest portion of the hide and to the cut surface a drop of the solution of phenol phthalein in alcohol is applied. If the cut surface turns red, it indicates that there is still some lime left; on the other hand, if no colouration is produced, it may be taken that the hide has been sufficiently delimed. Every hide is tested in this way and as soon as it passes the test is removed from the lactic acid bath and well washed in clean water.

*Pickling.*—The next operation through which the hides must pass is that of pickling, which gives a preliminary alum tannage to the surface of the hides and thus prevents, to a large extent, the formation of a drawn grain when the hides are finally tanned. For the pickling solution 6 lbs. of potash alum and 4 lbs. of common salt per 100 lbs. of the drained weight of the delimed hides are dissolved in sufficient water contained in a large rotary drum. The hides are put into this solution and kept in it for about 24 hours, the drum being rotated from time to time by hand.

Although chrome tanning can be carried on in pits or tubs, it is more convenient to employ large drums to hold the tanning solution. They are made locally of teakwood and are mounted on a suitable wooden framing. The weight of the drum is carried by two centrally placed brass rings one on each side which rest on friction rollers supported by iron pedestals attached to the

framing. On one side of the drum is fixed a large cast iron spur wheel of the same diameter as the drum and it is driven by a small pinion mounted on the framing. The drums we have constructed in Madras range from 6 to 8 feet in diameter and from 3 feet to 4 feet 6 inches in width. At present they are turned by hand, coolies being employed for the purpose, but it is ultimately intended to drive them all from a line of shafting. By hand power it is not possible to revolve them more than two or three times a minute, but when driven by a belt from shafting, the gearing will be arranged so that the drums make from 4 to 8 revolutions a minute. For tanning the slower speeds are sufficient, but for washing and delimiting a more violent action is desirable and the higher speed is necessary. Inside the drums strong wooden pegs are fixed so as to turn the hides over as the drums rotate. This greatly quickens the process of tanning and the drums can also be usefully employed for washing, pickling and for removing the last traces of acid after the tanning processes are complete.

*Chrome tanning.*—There are two methods of chrome tanning known respectively as the single and the double bath process. The latter probably produces the finest leather but the former is both cheaper and simpler to work and has been adopted in Madras exclusively as it yields sufficiently good results, and with the unskilled labour available there is much less risk of anything going wrong.

To secure uniform results and to save tanners, who are not chemists, from the risks of buying their own chemicals, a number of tanning liquors have been put on the market ready for use. Experiments on a fairly extensive scale were made with two of these—one, the well-known Tanolin which was supplied to us by the Martin Dennis Chrome Tannage Company of Newark, New Jersey, and the other, by Messrs. Lepetit, Dollfus and Gansser of Milan, whose Chromo-Chrome produced excellent leather. With both the results were quite satisfactory, but the leather was no better than that made, using the very simple process described by Professor Procter on page 212 of his "Principles of Leather Manufacture". The tanning solution is made by dissolving 10 lbs. of chrome alum in 4 gallons of water. To effect the solution readily the alum should be crushed to a fine powder. Between 3 and 3½ lbs. of ordi-

nary washing soda is dissolved in water and slowly added to the solution of alum. Rapid effervescence takes place and the mixture should be thoroughly stirred. If too much soda is added, a heavy precipitate is formed and there is a waste of valuable chemicals. The chrome alum costs in Madras Rs. 14-8-0 per cwt. or, roughly, 2 annas a pound and one pound of chrome alum is sufficient for the production of 3 lbs. of finished leather. The carbonate of soda costs Rs. 7-8-0 per cwt., equivalent to slightly more than one anna a pound and as only one pound of washing soda is required for 10 lbs. of leather, it will be seen that the total cost of the chemicals employed in the tanning solution is very small and is actually less than that of the bark used in the ordinary processes of tanning. The tanning solution prepared in the above proportions contains 25 per cent. of chrome alum and is used as a stock solution. By diluting it with water solutions of any strength are readily prepared. Usually tanning commences in a one per cent. solution and ends in a solution the strength of which is about 5 per cent.

The tanning is done in the drums already described and usually about 500 or 600 lbs. of pelt are put in each drum. The drums are arranged in a series through which the hides pass, first entering the drum containing the weakest solution and finally passing out of that containing the strongest. To the tanning liquor in the first drum about 15 lbs. of sodium sulphate are added to prevent the formation of a drawn grain. The time occupied in completing the tanning process depends upon the thickness of the hides. Sheep and goat skins are tanned in a few hours, cow hides in from one to three days, whilst the thick buffalo hides used as sole leather take from a week to ten days. The process could be quickened considerably if the drums were worked by night as well as by day and it would also be shortened if power were employed to drive the drums at a faster speed and continuously. The hides are considered to be tanned sufficiently when the blue colour produced by the chrome liquor has penetrated right through the hide and there is no white streak in the centre. Experience seems to indicate that there is considerable danger of producing bad leather by over-tanning and that where the hides are of very unequal thickness in different parts they should be rounded off as much as possible before being put in the tanning

drums. Leather which has been over-tanned soon becomes brittle and useless and it is impossible to emphasize too much the necessity for care at this stage.

As soon as it is decided that the tanning is complete the hides are removed from the solution and spread out one over the other on a wooden horse where they are allowed to soak and drain for 24 hours. The tanning liquor remaining in the hides contains a considerable percentage of sulphuric acid and it is absolutely essential that this should be completely removed or the leather will perish in a very short time. It may be here remarked that the three principal causes of the production of bad chrome leather are (1) over-liming, (2) over-tanning and (3) acid in the finished leather. It is not difficult to guard against damage arising from these causes once they are recognised, but there is no doubt that a good deal of chrome leather made both in Madras and elsewhere has been unsatisfactory through neglect to take proper precautions to prevent damage arising from the operation of any one or all of them. To remove the acid the hides are first washed in several changes of water and then drummed in a half per cent., solution of borax, the quantity of borax used being 3lbs. per 100lbs. of wet leather. Litmus paper is used to test whether or not the acid has been completely removed. When it is ascertained that the leather is free from acid it is taken out of the borax solution and well washed in several changes of water to remove any soluble salts that may have formed in the substance of the leather.

*Fat-liquoring.*—For leather which is not to be dyed this is the final chemical process to which it is subjected, any further treatment being of a purely mechanical nature. The “Fat-liquor” is an emulsion of oil in a solution of soap and when the chrome leather is put into this the oil is absorbed and renders the leather soft and pliable. The soap employed is made in the following way:—

One hundred lbs. of castor-oil selected, because it is both cheap and gives satisfactory results, are placed in a wooden tub and 20 lbs. of caustic potash are dissolved in water and allowed to cool. When cold the caustic potash solution is slowly poured into the castor-oil, the mixture being constantly stirred and the stirring is continued for about quarter of an hour so as to ensure

that the potash and oil are thoroughly mixed. After about 24 hours the soap is ready for use.

To prepare the fat liquor 7lbs. of the soap are dissolved in two gallons of boiling water to which is added an equal quantity of castor-oil and the mixture is boiled. It is then placed in an emulsifier which consists of a cylinder made of tin plate about 3 feet 6 inches high and about 10 inches in diameter. In this works a loosely-fitting piston attached to a long handle. The piston is perforated with a large number of small holes and by working it up and down the cylinder after the mixture of oil and soap has been put in the emulsification is completed. When it is desired to produce the better qualities of leather 2lbs. of egg yolk are added to the emulsion and thoroughly incorporated with it. When the emulsion is properly prepared it will mix with hot water without showing any trace of oil. For leather intended for water bags and rough usage it is desirable to make it absorb as much oil as possible and in practice we find that about 10 per cent. will be taken up by the leather. This gives the surface a dirty appearance but that is a matter of no consequence.

The hides are fat-liquored in a drum which has been previously heated by means of boiling water. The door of the drum is closed and the requisite quantity of concentrated fat liquor diluted with sufficient hot water at a temperature of 140° F. is passed in through the hollow axle of the drum which is then set in motion. After drumming for about half an hour it will be found that the fat liquor has been entirely absorbed by the hides which are removed and laid over a horse to drain for several hours. Afterwards the hides are sleeked on stone tables and then stretched on wooden frames to dry. When the hides are dry they are taken off the frames and subjected to the staking process which gives the leather that softness which is one of its principal characteristics. This completes the process of converting both skins and hides into undyed chrome leather. When it is essential that the leather should have a good appearance the percentage of fat-liquor which the hides are allowed to absorb must be reduced and when the staking operations are completed a little French chalk is dusted over the grain side. As we have no machinery for staking or shaving leather, the flesh side of the leather is necessarily rough and ragged and

for any work in which a certain amount of finish is required the leather has to be shaved by hand.

*Sole leather.*—The process of unhairing now employed when the hides are destined for sole leather has already been described. The tanning takes from a week to ten days and the subsequent removal of the acid has to be carefully attended to on account of the greater thickness of the leather. It seems doubtful whether the process of fat-liquoring is necessary. At present the leather is drummed in a concentrated solution of the fat-liquor, the proportion employed being about 5 per cent. of the weight of the sammed leather. After fat-liquoring the leather is brought into a sammed condition either by allowing it to dry naturally or by passing it between a pair of rollers. When nearly dry it is ready for stuffing. The composition of the mixture employed is as follows:—50 lbs. of Burmese paraffin, 12½ lbs. of tallow and 2½ lbs. of resin. For the stuffing process it is advisable to use a flat copper or aluminium dish large enough to take the biggest of the butts which go through the process. The dish should be from 6 to 8 inches deep and supported on an iron frame. Underneath a fire is placed and the mixture of paraffin, tallow and resin melted. The sole leather butts in a sammed or partially dried condition are put into the melted mixture the temperature of which is sufficiently high to cause the air in the pores of the leather and the remaining moisture to rapidly pass off in bubbles. The stuffing penetrates thoroughly into the substance of the leather, and when all the moisture has been driven off as is indicated by the cessation of the stream of bubbles rising from the surface of the leather, it is removed from the dish and allowed to drain. As soon as it is cold the leather is rolled under considerable pressure between heavy rollers and is then ready for use.

*Dyed leathers.*—Most of the leather required for boots and shoes, saddlery and similar articles has to be dyed either black or some shade of brown as the natural colour of the leather meets with but little appreciation. This adds considerably to the cost of the leather and from the beginning it was recognised that it would be desirable to devise a simple process which could be carried out without having resort to the comparatively expensive aniline dyes. Experiments in this direction have resulted in the production of a very satisfactory brown leather pre-



pared by subjecting the neutralised leather after it leaves the tanning solution to a superficial tannage with avaram bark (*Cassia auriculata*). The tanning liquor contains about 5 per cent. of bark and the hides are drummed in it for about half an hour. They are then removed and washed, and again drummed in a solution of Bichromate of Potash, there being about 8 oz. of the salt to every 100lbs. of summed leather. After this the leather is fat-liquored and finished in the usual way. The depth of colour can be increased by prolonging what is practically a bark-tanning process till in the extreme limit a combination tannage is produced which will be dealt with later on. The brown leather thus produced was first intended only for the uppers of cheap ammunition boots. When worked up with the ordinary leather dressings, it has proved quite satisfactory for all classes of goods though many people prefer a much darker colour.

Coloured leathers for boot uppers pass through exactly the same processes as those already described, but it is permissible to allow of a somewhat longer liming so as to produce greater softness and flexibility. It is best to apply a mordant to the leather after the acid has been washed out of it and before the fat-liquoring process. The dyes employed are all aniline dyes and to fix them satisfactorily the leather must first be mordanted with some vegetable tanning material. In Madras we have found avaram bark both cheap and satisfactory. The leather, after being neutralised, is well struck out on the grain side and then transferred to a drum containing the decoction of bark of which about 5 per cent. on the weight of the summed leather is employed. The temperature should be about 140°F. and the drumming should last for about half an hour. The leather which will then be of a light yellow colour is removed and washed in several changes of water, after which it is spread out on the sleeking table and thoroughly struck out on the flesh side so as to remove as far as possible all surplus moisture. The leather is now ready for fat-liquoring, about 5 per cent. of which is used on the struck out weight of the leather. The fat-liquoring is done in a drum at a temperature of about 160°F. and when all the oil has been absorbed the hides are taken out and piled on a table where they are allowed to remain and gradually cool down. Each hide or skin is dipped in hot water and then well struck out on the grain side so as to remove all surface grease

which, if allowed to remain, would make the subsequent dyeing uneven. With the enormous number of dyes now available any colour and almost any shade of that colour can easily be produced by using suitable combinations. So far we have not attempted to do anything more than turn out a good black dyed leather or brown leathers in light, medium and dark shades. For experiments in book-binding leathers a few coloured skins have been produced and a fair number of skins have been dyed scarlet to satisfy the taste of Mahomedans in the matter of chadras.

The dyes we employ are mainly of English manufacture, being phosphine substitute, new acid green, azaflavine R and acid green. The proportion in which they are mixed depends upon the colour required and as typical mixtures the following are given:—

- (1) 4 oz. of phosphine substitute and 1 oz. of new acid brown.
- (2) 3 oz. of phosphine substitute, 3 oz. of new acid brown and  $\frac{1}{4}$  oz. of acid green.
- (3) 4 oz. of phosphine substitute and 3 oz. of new acid brown.
- (4) 5 oz. of phosphine substitute, 2 oz. of new acid brown and  $\frac{1}{2}$  oz. of acid green.

These quantities are for a dozen average sized skins. The total quantity of dye stuff required varies with different classes of skins, about half an ounce being required for a sheep skin and a little over an ounce for a light cow hide. The aniline dyes are dissolved in boiling water and the solution is filtered to remove any suspended impurities. The dyeing is done in drums at a temperature of about 150° F. About half the quantity of the dye stuff is used at the outset and the rest is added after about quarter of an hour. At the end of another 30 minutes three-fourths of the dyeing liquor is run out of the drum and egg yolk added to the extent of about 1 per cent. on the struck out weight of the leather, after which the drumming is continued for another 20 minutes when the goods are removed, horsed up and struck out. The skins are stretched on boards or frames to dry and the grain side is lightly rubbed over with a mixture containing 20 per cent. of glycerine in water. Before the skins are quite dry they are removed, being then in a good condition for staking

which is entirely done by hand. After staking the colour may be improved by topping with a half per cent. solution of the dye used warm and applied with a soft brush. When this is done the goods should be again staked and then finally dried right out so as to be in a condition to receive a coat of seasoning.

*Seasoning.*—This is made by taking 3 oz. of white of egg and one pound of milk and making up with water to one gallon adding sufficient of the dye solution to tint the mixture. The seasoning is applied lightly on the grain side and when the goods are sufficiently dry they are glazed in a pendulum machine and afterward re-staked and then the seasoning and glazing processes are gone through a second time, at the end of which the leather is ready for use.

*Blacks.*—Experiments with aniline dyes such as Corvoline B. T. using Cutch as a mordant have not been very successful, and we have obtained better results with Haematine or logwood extract followed by the application of ferrous sulphate. About  $1\frac{1}{2}$  per cent. of logwood extract calculated on the drained neutralised weight of the leather is dissolved in water to which is also added a quantity of washing soda equal in weight to about one-eighth of the weight of the logwood extract. The leather is first drummed in this solution and in about half an hour obtains a deep blue-black colour. The goods are then removed from the drum and sleeked well on the grain side and "pleated," i.e., the skin is laid on the table, doubled down the ridge with the flesh side inside and the shanks and belly are sleeked over so as to stick them together, the idea being to keep the flesh side protected from contact with the iron solution through which the goods are now passed. This consists of a 1 per cent. solution of ferrous sulphate through which the skins are pulled twice and then immediately washed in hot water and struck out. The iron in the ferrous sulphate acts upon the small quantity of tannin present in the logwood extract and turns the blue-black shade into a thoroughly good black. It is necessary to carefully remove any excess of ferrous sulphate that the leather may contain or the process of fat-liquoring will be unsuccessful. This operation is identically the same as for brown leather and need not be described again. The seasoning for blacks should be of the following composition:—

Two oz. of logwood extract is dissolved in a quart of hot water and allowed to cool;  $\frac{3}{4}$  oz. of ferrous sulphate in a quart of cold water. One pint of blood, 1 pint of milk and  $\frac{1}{2}$  oz. of glycerine are diluted with one quart of water. To this the logwood extract solution is added and the whole well mixed. Finally the ferrous sulphate solution is added and the whole made up to one gallon with water. The mixture is applied with a sponge and the goods glazed for the first time whilst very slightly damp. The staking, seasoning and glazing may with advantage be repeated after which the leather is ready for the market.

*Combination Tannage.*— For some purposes chrome leather is distinctly inferior to well tanned bark leather and it is possible by subjecting the hides to both processes to obtain a material which possesses in a marked degree the good qualities of both tannages. The production of such leathers will, of course, be much more expensive than when either process is used alone, and till quite recently it has been considered outside our sphere of work to attempt to produce the more expensive kinds of leather. In certain directions, however, we have met with a distinct demand for a locally produced leather of high quality and this we have endeavoured to meet by supplying combination tannages.

There are three ways of carrying out a combination tannage. Either process may be carried out first, or the two tanning liquors may be mixed together and allowed to act simultaneously. Most excellent leather has been produced by purchasing from local tanners hides and skins which have been lightly tanned in avaram bark but not subjected to any process of dyeing with myrobolans or stuffing with grease. These lightly tanned kips or skins were chrome tanned in the usual way and either finished in their natural colour or dyed brown or black. The resulting leather has proved very suitable for many purposes and as the natural colour is a not displeasing brown, it does not really cost anything more than ordinary chrome leather dyed brown. In a similar way sole leather has been made from combination tanned hides, but there has not yet been time to ascertain whether there is any very marked advantage in the process. For highly finished boots it can certainly be employed as it lends itself more readily to a neat finish than does ordinary chrome sole leather. So far it has been mainly with a view to producing good harness leather that we have experimented with combination tannages and we

have arrived at the definite result that there seems to be a limit to the amount of stretch in combination tanned leather, and stirrup leathers made from it have proved quite satisfactory and have shown no stretch whatever after being made up. Harness similarly has proved extremely satisfactory and being unaffected by moisture has proved in every way suited for damp climates and wet weather. The combination tannage produces an excellent leather for boot uppers, having rather more body in it than ordinary chrome leather whilst, at the same time, it is equally soft and unaffected by water.

Experiments have also been made in which the hides are first subjected to the chrome process and then tanned in an avaram bark solution. As already mentioned, this process has been largely employed more with a view to dyeing leather than to materially altering its properties and so far it has proved perfectly satisfactory. Experiments with a more prolonged vegetable bark tannage have not been satisfactory, and, at present, it seems doubtful if this order of tanning will be able to compete with that in which the vegetable process takes precedence. Tanning with mixed solutions has not yet been tried.

*Cost of Chrome Tanning.*—In native tanneries in the Madras Presidency, the rate usually charged for tanning hides varies from 2 to 2½ annas per lb. on the weight of leather produced. Chrome tanning costs us slightly over 3 annas per lb., so that, if allowance be made for the smaller weight of chrome leather produced from a given weight of hides, the actual cost of tanning a hide by the chrome process is no greater than by the bark process.—Dyed leathers, however, cost considerably more, but then they are only used for superior work, and it would be unfair to compare them with the normal productions of a country tannery. It is important to remember that the chrome process of tanning is a much shorter one, and that, consequently, much less capital is locked up in the tannery. The saving of capital, which is thus effected, is more than sufficient to provide for the extra expense in plant and machinery which a well-equipped chrome tannery involves when compared with the ordinary bark tannery.

*Conclusion.*—The processes of chrome tanning which we follow in Madras have been described in the above general terms not because there is any novelty about them, but because

there is in India an idea more or less prevalent that chrome tanning involves the introduction of machinery on a large scale and methods of operating better adapted for employment among more advanced communities. Whilst the trade in hides and skins is in a flourishing condition, the art of tanning in India, except in a few tanneries, is in a deplorably backward state. In the Madras Presidency, where the tanned skin trade represents the highest development of native tanning, nearly all the best skins are bought up and exported to Europe or America in a raw state. Last year the average value of each raw skin exported was nearly Rs. 1-12-0, whilst the average value of tanned skins was only Rs. 1-3-0. The report of the Committee of the Society of Arts on leather for book-binding condemned East of India skins tanned with avaram bark as being the worst and most unfit from which to manufacture book-binding leathers. This was not due to any defect in the skins themselves, but solely because avaram bark contains catechol tannin and experiments have clearly demonstrated that, to secure the necessary durability in leather bindings, those only which have been prepared with a pyrogallol tannin can be used. The effect of this report has been to restrict the market for Madras tanned sheep and goat skins and to encourage the export of all the best skins in the raw state. Myrobolans and divi-divi both yield excellent pyrogallol tannins. The former are already exported on a large scale, and it would probably be wise to ascertain whether these natural products of the soil could not be utilised, not so much to bolster up a moribund industry as by a re-arrangement of ideas, to create a new one. The hides and skins of the domestic animals of India have come to be an important asset, and it seems desirable that the most, that can be made, should be made of this national source of wealth. The abolition of the crude system of branding cattle which now prevails would probably add fully a crore of rupees to the value of the exports of hides, and the abolition of the village tanner would even lead to greater results. It will probably be a long time before the people can be induced to abandon branding, but the gradual extension of the chrome process and the keener demand for raw hides which the enhanced value of leather now enables dealers to offer will do much to improve the methods of realising the real value of hides and skins.

## PLANTAIN FIBRE.

### MR. J. N. BANNERJEE.

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THE object of the present note is to draw attention to the common plantain as a latent source of an immense quantity of fibre which has hitherto been practically wasted and which might be turned to account by the Indians, to furnish some information about the extractor, the mode of extracting fibre, its outturn per bigha, its value and the costs of extracting it, &c.

The existence of fibre in the common plantain has probably been known in India from ancient times, and its value and utility have been brought prominently to public notice at intervals from time to time. At the time of the temporary suspension of the supplies of Russian hemp to the English market by the occurrence of the Crimean War, the Government instituted an enquiry as to the different kinds and relative values of fibres obtainable in India. The information obtained was interesting and valuable at that time. The main reasons for not making use of the fibre contained in the stems of the common plantain are: (1) general ignorance of its existence; (2) the comparative abundance of other species of fibre-yielding plants which can be easily and profitably grown by the people and with whose fibres and with the means of extracting them they have long been familiar; and (3) the want of some simple, but efficient machine or an appliance, suited to their means for extracting the fibre.

My experiments have shown that an average plantain stem cut for fruit would give about  $\frac{3}{4}$  of a seer of the clean lustrous long stapled and commercially valued fibre. An adult with a week's experience can work about 8 stems a day, a boy, being given to assist him in tearing the sheaths into longitudinal pieces of  $\frac{1}{4}$  inch width and in collecting the broken fibre and in drying them, and these in the sun the fibre extracted. The adult's wages being put down at four annas and the boy's at one-half an anna one will get in a day seven seers of fibre, for five and a half annas. Even taking the outturn as per experiment granting that especial men are to be engaged for fibre extracting works, the charges of extracting one ton of fibre from plantain stems as

they are cut for fruits amount to lbs.  $2,240 \times 5\frac{1}{2}$  as.  $\times 14$  lbs. or Rs. 55 a ton. Add to this Rs. 40 for freight, trader's commission, insurance, bailing, cooly and cartage, &c., the total comes to Rs. 95 or in round figures it reaches to London at Rs. 100. Compare this with the quotation received recently from the London Chamber of Commerce even taking the value at only the lowest price, viz, Rs. 35 a ton, there is a net profit of  $35 \times 16$  or Rs. 560 less Rs. 100 or Rs. 460 for a ton of fibre.

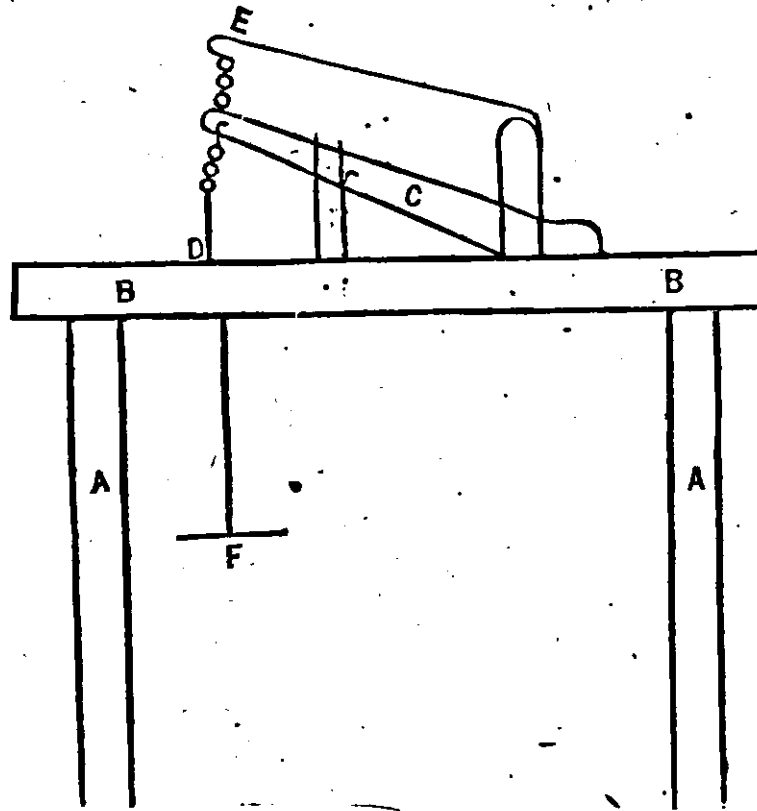
On a bigha of plantain in these parts of Bengal are grown about 400 plants; so the outturn per bigha will be about 9 maunds, which would draw a clear income of Rs. 150. The profit to the agriculturist owner will not be all the Rs. 150; it may be put down at least Rs. 25 a bigha, as this means conversion into money of fruit cut stems thrown away to rot on the ground. I venture to say it is opening a new source of agricultural wealth. There is no special expense to be incurred for fibre industry. Remember that the said income of Rs. 150 per bigha of plantain is over and above the value of fruits and leaves obtained from the plantain stems which may be at least 2 annas a stem and at a minimum net income of Rs. 25 in a bigha, plantain fruit being 18 months crop, the annual income per bigha from both plantain fruits and fibre is Rs. 150 + Rs. 100  $\times 1\frac{1}{2}$  years or Rs. 250 or Rs. 166 per year (a bunch of fruit is sold from 8 annas to over 12 annas), from a trader's point of view. There is an easier method of presently starting industry. Rather than waiting for 18 months for the growth of plantain tree, the numberless stems available from places scattered here and there over several villages may be utilised if they can train their men or labourers to extract the fibre of each stem as it is cut for fruits. This may be done for sale to the agent of the Central Factory when he may turn up every now and then at their villages for purchasing the available fibre. And there they can make a net profit of at least Rs. 25 per bigha over and above the income from fruits and leaves. Let them, therefore, induce all plantain owners to take to the extracting of fibre after the stems are cut. I have arranged to supply the cheapest machine for extracting fibre at Rs. 15 each. This can be seen at the Industrial Exhibition.

The machine is strong and simple in construction, portable and efficient to easily extracting the fibre of plantain sheaths.



The fibre extracted is so strong that a fine rope may be made out of it equal to aloe or manilla hemp, and when dyed in different colours, it may be manufactured into different kinds of beautiful heavy goods such as carpets, rugs, window screens and good many useful articles.

DIAGRAM.



*A.* Two posts fixed on the ground to support the horizontal beam *B.* *C.* The links to obtain the required pressure of the blade of the knife on the fibre. If the spring *E* becomes weak, attach the knife to the spring by the shorter link *D.* *F.*, a piece of cord tied to the end of the handle of the knife passing through the hole in the horizontal beam. The other end of the cord is tied to a pedal.

“HOW TO MANIPULATE.”

The plantain stem should be cut soon after the tree has borne fruit when it is 18 months old. Each length should be spilt into strips of  $1\frac{1}{2}$  inches broad. The length may be

cleaned on the same day as the stems are cut down and about an hour after stripping. The inner portion yields a better fibre than the outer, and should be collected separately. The strips are placed innerside uppermost under the open knife, the foot being on the pedal. Keep hold about 7 inches of the end of the strips and with both hands draw the strips steadily, after taking the foot off the pedal, first under the gugged portion of the blade and then under the blunt edges.

This should be done two or three times and then a few times outside the uppermost. After the cleaning of one end is finished, the other end should be cleaned similarly. Then the fibre will be thoroughly dry in a short time. Sunlight should not be visible between the knife and sole plate, and any wearing out of these parts should be detected and rectified.

Planters, Zamindars and especially the villagers who have plantains growing on their estates and in their gardens might, with the aid of this machine, very easily and without much expense, obtain all the fibre necessary to make cords and ropes for their own requirements.

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## ESSENTIAL OILS.

MR. J. N. BANNERJEE.

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IN some parts of Bengal there are various kinds of grass which grows luxuriantly from which we can easily extract the essence of lemon and peppermint, with a trifle cost. It has a strong lemon and peppermint-like odour which does not usually fade even when cut or dried.

Put the same grass in an earthen pot half filled with water, and close the mouth with a well-fitting cover securely fixed with flour gum. This cover has a central hole in which is placed a pipe of the shape of an inverted tobacco pipe, and similarly fixed. The whole apparatus is to be placed on an oven, and at the end of the pipe should be held a glass flask immersed in a tub full of cold water. The hot water vapour and with it the otto or essence of the grass will come over and will be condensed in the flask. At the end you would find drops of a very fragrant oily substance floating on the surface on the water in the flask. These drops should be separated by a piece of new blotting paper. This is, I believe, the lemon-otto or essence as well as peppermint too, sold in the bazaar. When this otto is dissolved in ether or alcohol, the essence is prepared. The water left in the flask will have a very pleasant smell and, I think, might be sold as lemon or peppermint water, for it is in no way inferior to rose water in its scent and refreshing qualities.

I can arrange myself to supply those gentlemen who intend to cultivate lemon or peppermint grass with seeds at a very nominal price.

The plain and simple apparatus described above and almost entirely made of earth, and therefore quite inexpensive, is worthy substitute for the rather costly metal distilled apparatus of the market and can be easily obtained by giving orders to a potter and used with success. Instead of the glass flask a long-necked pitcher might be used.

## GLASS-MAKING.

Mr. Alakh Dhari.

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GLASS is an article that is mainly formed by fusion through heat of two substances, viz., silica and alkali. A remarkable feature of glass is its ductility, that is to say, when in molten condition it attains a peculiar sort of gluey adhesiveness which enables it to be gathered round the end of a tube and blown into, expanding and making it hollow from inside, and moulded into any shape or size. On cooling it turns hard, though brittle, and retains the same shining smoothness and brilliant appearance that may be imparted to it when still hot. Glass can be made of any shade or colour, opaque or transparent. Climatic changes produce no damaging effect on it nor age cause decay.

Besides the manufactured article, a kind of native glass, called *obsidian*, is sometimes found in the vicinity of volcanic mountains. Obsidian glass is a substance to which, it is generally believed, vitreous lavas turn themselves on cooling. Samples of obsidian have been analysed and found to contain silicate of alumina, iron and potash or soda, etc. The name obsidian is said to have been given to it by that famous ancient chronicler and traveller, Pliny, after a certain individual, Obsidious, who, according to Pliny, discovered this substance in Ethiopia. It is said that in olden times cutting instruments and rings, etc., were made of this glass in Mexico and other countries.

It will, perhaps, be news to many that the manufacture of glass is not a new industry in India, for we find Pliny and other historians of yore making mention of glass articles having been found in India. We also read that, "in the tope at Mannikyla in the Punjab, opened by General Cunningham, which appears to date from about the Christian era, was found a glass-stoppered vessel and similar (other) vessels or fragments have been discovered in other topes of a later date" as well. In ancient Egypt the glass-making industry had actually made wonderful progress, and some of the works of art prepared in those days (that have now been unearthed) display an amount of perfection and proficiency that it is difficult to even now surpass.

## RAW MATERIALS.

The principal ingredient of glass is silica, commonly known as sand, and the quality of sand alone does in a great measure determine the quality of glass. A great many impurities are generally present in sand, but none of them is so detrimental to the manufacture of glass as the mixture of iron from which, unfortunately, sands are rarely free. Arsenic is sometimes used to nullify the bad effects of iron, but it is not always successful; besides, it is never possible to use arsenic in large quantities on account of its high price. The glass-makers, therefore, remain on the look-out for iron-free sands. The presence of iron can very easily be detected by first dissolving sand in muriatic acid and then pouring a few drops of potassium ferrocyanide (dissolved in water), when, if any iron is present, blue clouds would be formed. This is a most powerful (qualitative) test and has been found to disclose the existence of iron even where that substance is present in the very small proportion of one part in about two hundred parts of sand. Should any effervescence take place at the time of dissolving sand in the acid, it generally denotes the presence of chalk or a carbonate. Ordinary sands containing a little portion of iron can conveniently be used for green bottle-glass. But for manufacture of white-quality glass, if no better sands are available, the best course is to thoroughly burn sand, (or stone from which it is to be powdered) to allow extraneous matters to escape in gaseous form. The process of burning sand consists in placing it on the bed of an oven and subjecting it there to the flame of fire in its passage from fire-place to flues.

A sample of French sand that is regarded as quite pure for ordinary white glass was, on analysis, found to contain—

Silica .. .. .	395 parts.
Oxides of manganese, aluminium and iron ..	2 parts.
Moisture .. .. .	3 parts.

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in 400 parts.

Hardly less important than the silica is the element of alkali through whose agency sand and other raw materials are melted and reduced to glass under heat. There are at present only two alkaline substances that are largely used in the manufacture of glass, *viz.*, potassium and sodium carbonates.

Potassium carbonate had until recently been manufactured from wood ashes. Roughly speaking, the process of conversion consisted in burning piles of wood to ashes and pouring water over the same allowing the soluble portion to flow out. The residue was re-dissolved and calcined forming potassium carbonate of commerce. This mode of manufacture is, however, being abandoned and this substance is now obtained from potassium chloride deposits in Germany and elsewhere, but on account of its high price potassium carbonate is not so much used as the sodium carbonate, which, also, was formerly produced from plants in somewhat the same manner as the former, but is now manufactured from common salt by what are known as the Le Blanc, the ammonia-soda and the electrolytic processes.

In the Le Blanc method common salt is subjected to the action of sulphuric acid forming acid sodium sulphate, which is then placed in a reverberatory furnace and turned into anhydrous sodium sulphate. On roasting it with coal and chalk a black-coloured substance known as the black ash is formed. Lixiviated in a number of tanks, black ash yields a pretty pure carbonate of soda. In the other process, gaseous ammonia has to be passed in a solution of salt and water and played on by carbon di-oxide gas until it is thoroughly saturated. The acid carbonate of soda, which is thus formed, is heated and turned into the carbonate of commerce. But both these modes of preparing sodium carbonate are being speedily abandoned as the ever-vigilant and progressive West has now hit upon an electrolytic process which would effect a great economy in the cost of manufacture.

Attempts have, from time to time, been made to replace the use of sodium carbonate by common salt itself in order to dispense with the troublesome and somewhat expensive process of converting it into a carbonate. We have read of a Mr. Gossage having experimented the manufacture of glass by using chloride of calcium in vaporised state through a tower filled with heated sand-stones but the silicate of soda produced by this method was not presumably found suitable, or we would have seen this process generally adopted. Later on, we find Mr. George Gore trying to produce the silicate of soda in the glass-pot itself. He devised a mixture of sand, chalk and salt from which steam could only be liberated at high temperatures and thus under conditions most favourable for the decomposition of

salt. A tolerably transparent glass is stated to have been produced but the cost proved prohibitive. Experiments with sodium chloride (as the alkaline agent) are being still carried on now and then, and it is not beyond the range of possibility that a day may soon come when we would find this knotty problem satisfactorily solved.

Though glass can be manufactured from sand and alkali alone, it is very necessary to include some portion of limestone as well in order to make the glass hard and brilliant. Lead is sometimes used as a substitute of, or as a supplement to, lime to impart a greater brilliancy.

When it is desired to give any colour to glass we have to mix oxide of cobalt for producing blue colour; oxides of chromium, copper or iron for producing green; oxide of uranium for yellow; oxide of manganese for violet; and oxide of gold for red colours.

The art of colouring glass is, however, very difficult and subtle. Much depends on the skill of the manufacturer in properly adjusting the degree of heat and in using the materials in due proportions, the least variation producing undesirable results.

I read in a South Kensington Museum Art Handbook that a Mr. Bontemps once "brought forward some very extraordinary facts in connection with the colouring powers of different bodies. He showed that all the colours of the prismatic spectrum might be given to glass by the use of oxide of iron in varying proportions and by the agency of different degrees of heat, the conclusion being that the different colours are produced in their natural disposition in proportion as the temperature is increased" or lowered. The analyses made of pieces of ancient glass adds weight to this statement, for therein we find that one and the same ingredient was contained in glasses of different colours. But so long as the modern science of chemistry does not make any specific discoveries in this respect and the glass-makers do not find it practically safe to adopt those new methods, the general practice of using different oxides for producing different colours is likely to remain in force.

In the manufacture of glass we have to use, roughly speaking, one part of alkali in two parts of sand. The price of alkali is, however, far higher than that of sand and the cost thereof is,

therefore, perhaps, the largest item in a glass-maker's bill of expenditure. Besides glass-making, alkaline soda is largely used in the manufacture of soap and paper and, in a lesser degree, in cotton spinning and dyeing as well, so that there is a very great demand for this article in India. The representative of a firm of importers in Calcutta, when he called at our Glass-Works in Ambala last year, informed me that his firm alone had imported about 90 tons of soda the year before. There are several firms in Calcutta and other sea-coast towns whose import business is believed to be in no way smaller than that of the firm above referred to. One can thus imagine what enormous quantities of alkaline soda are imported in India from year to year. It is a matter of great regret that, in spite of our extensive natural resources, no real attempts have yet been made to establish any factories for this purpose in our country. The many sodium chloride deposits and that extremely cheap substance known as *reh* or *usar* which abound in plenty in Northern India will, it is believed, yield beautiful sodium carbonates, cheap in price yet strong in alkaline properties, if they are only properly manipulated. Unless, however, the prospective alkali-manufacturer in India devises means whereby the number and the quantity of bye-products is considerably minimised (and good markets found for them so that the allotment of expenditure on the main product may be lessened) and efforts are made to use the cheap materials available on spot in the manufacturing process, the chances of our being able to compete successfully with the European supplier are far remote.

I hear there are some very fine cobalt ore mines in the Himalayas. The exploiting West discovered one and immediately leased it, securing a monopoly. A great portion of the vast quantities of cobalt oxide that are used in India and for which we have to pay at about seven hundred to eight hundred rupees a maund are, perhaps, nothing else than the Indian ores of cobalt carried to Europe and refined there, to be eventually brought back and sold amongst us at enormous profits.

#### FURNACES, CRUCIBLES AND ANNEALING OVENS.

A glass-maker's work is, however, only partly done when he has brought together and mixed in due proportions the



different raw materials. He has next to erect a strongly refractory furnace,—a furnace that would successfully withstand intense heat and at the same time be worked with economy in fuel.

Great care ought to be bestowed on the selection of materials from which furnace bricks are made. Not only should the bricks and clay used be perfectly refractory at the temperature required for melting the glass, but they should also, as far as possible, be free from metallic oxides. The kind of bricks which in England and Germany go under the name of *Dinas* have been found greatly superior in this respect. They consist entirely of good silica bound together with a small portion of lime. The fire-clays found in Stourbridge-shire (England) are noted for their excellence but for ordinary purposes the fire bricks of Jubbulpore are also quite good. At our request the Manager of the Perfect Pottery Company, Limited (Jubbulpore), had some samples of his clay chemically analysed along with some samples of superior quality European materials, and Dr. Schulten, who analysed them, was of opinion that the Jubbulpore clays were in no way inferior to the foreign stuff.

The part of the furnace that requires great care in construction and necessitates the use of very excellent material is the crown or dome. I have not yet been able to ascertain whether the Jubbulpore fire-bricks can be used with sufficient success in building crowns as well, but there is no doubt that, in other parts of the furnace, we can (with some judicious discriminations) safely use Jubbulpore materials.

Among glass-makers of the present day the furnace wherein heat is produced just below the pots, and the flame rises directly into it, is in common use. It is cheap and simple, and undoubtedly best fitted for manufacture of glass on a small scale. But in order to produce superior glass, what is known as the gas furnace is preferred. In this, the steam is generated a little way off and before reaching the crucibles, it gets purified and freed of unburnt carbon particles. It must be remembered that it is in the furnace only that raw materials are melted and reduced to glass and that its quality, too, greatly depends on heat, which, if insufficient, causes, among other defects, bubbles (unliberated air) and specks (unfused carbon, etc.), and also gives to glass a

sort of dull dimness in colour. To produce pure and transparent glass a furnace must have a strong, regular and steady flame of fire.

Furnaces, again, are of two kinds. One is called the tank-furnace and in this glass is melted in hollow spaces built in the body of the furnace itself, but as the tank furnaces require great attention and large initial outlay of money, they are not usually built unless it is desired to melt large quantities of glass of only a certain kind. In Europe and elsewhere tank furnaces are generally found only in factories which manufacture bottle-glass. By far the most commonly-used type is of the pot-furnace. A pot-furnace does not, in the first place, require much initial outlay. It affords great facility on account of the crucibles (i.e., the pots in which glass is melted) being put in and removed at will.

Crucibles are of different capacities varying, ordinarily, between two and six maunds and as several of them can be put in a furnace, glass-makers can easily prepare different kinds of glass at one and the same time, which is a great convenience, particularly for small factories that have to cater for different tastes and in different coloured articles but are unable to have many furnaces.

Crucibles, too, are made of fire-clay. Raw and burnt fire-clays are ground and mixed together in proportion of about 7 to 9, respectively, but this proportion varies according to the relative qualities of clays used. The clays are mixed together well when still dry. Water is then poured on them and they are kneaded or treaded well by human feet. The latter process is, however, common on account of a supposition being prevalent that the elasticity and warmth of men's feet gives the paste a particularly gluey character. The paste is allowed to rot for about a week.

The crucible used for ordinary glass is open at the top and its walls slightly incline outwards as they go up, but for fine glass covered pot is preferred in order to avoid unburnt carbon particles or pieces of clay from the crown falling in and spoiling its quality. The covered pot is provided with a hole on one side through which raw materials are put in and glass taken out. A fixed and even temperature is maintained in the room in which crucibles are made. Indeed, in winter season it is desirable to

artificially heat the room in order to keep the air within at an uniform temperature. After the pots are made, they are generally allowed to dry and mature for about four or five months before being used. They are then put in a baking oven and the heat cautiously increased, until, gradually, in about a week's time the temperature is raised equal to that of the melting furnace itself. The old pots are then taken out of the (melting) furnace and new (baked) ones put in. The removal of old pots and the putting in of new ones is a work of great courage and pluck. The pots, besides being very heavy, are so hot and the heat of the furnace is so strong that it becomes very difficult to properly handle and control them. After they are put in the furnace, the crucibles are glazed all over with molten glass, so that they may become less susceptible to actions of alkali, which is a most dreadful enemy the pots have contended against. It persistently attacks the crucibles and is sure to corrode in if there happens to be any weak spot in the sides or base. When alkali has once succeeded in making a breach, it mercilessly continues its onslaughts and makes the aperture deeper and deeper so that a hole is eventually pierced through and glass flows out. Numerous devices are employed to patch up these holes, but a pot is practically done for when a hole is once made in it.

The length of time required to reduce raw materials to glass depends on the size of the pot and the intensity of heat available. In our Glass Works at Amballa we have at present pots of about five maunds capacity and have a heat of about 1,110 deg. Farh. It takes us about fourteen hours to melt an entire pot of metal (glass). When melting operations are complete, the temperature of the furnace is reduced a little to enable the glass to solidify a bit. It is then taken out and moulded in the desired shapes and forms.

The articles thus made are necessarily very hot, and, as a sudden reduction of temperature causes cracks and breaks, a process of gradual cooling is gone through, for which purpose they are put in annealing ovens where a small fire is kept burning at the time, but it is later on reduced and eventually extinguished. In Japan the annealing is done by putting glass articles in beds of sand or ashes. Here, too, this method would suit very well if some cheap method of first heating the sand could be found out.

After annealing the glass articles are given the necessary finishing touches and sent to market for sale.

SKILLED LABOUR AND FUTURE PROSPECTS.

The glass-making industry has a great future before it in this country, but many difficulties have first to be surmounted. The supply of skilled labour is for the present a problem that stares us in the face. We can never hope to compete with foreign manufacturers if we have to import artificers from abroad. They have usually to be paid cent. per cent. higher wages than what they get in their own countries. We, too, cannot reasonably expect them to part with those dear and near to them and leave their homes behind without our compensating for same in the form of increased salaries.

The only articles available here are sand and fuel, and of these, even, there are not many sands in India which may be regarded as pure, and in having to powder them from quartz stone the cost runs high. As regards fuel, our coal or wood is certainly not much cheaper than what these commodities cost abroad. Again, most of the colouring chemicals as well as alkaline substances and other ingredients have to be imported from other countries and it will be a considerable time before India would be able to make herself self-dependent in these respects. If we add to this foreign artificers as well, where will our economy lie? Our hope of success must, therefore, rest on our training-up of our own men, and for this purpose some of our youths should go abroad every year. The efforts made by the Calcutta Association for industrial development and other philanthropic countrymen in this direction no doubt deserve our best thanks, but what I wish to point out is that our present rate of progress falls far short of what the exigencies of the situation demand. In order to fully develop the vast natural resources of our country, we ought to greatly augment the number of our young men receiving industrial education in foreign countries.

But even studying abroad is not easy. Foreigners know well that our markets would be closed to them as soon as we begin to manufacture our own articles, hence their reluctance to impart any industrial education to our men. We cannot very well blame them for their adverse attitude in this respect, for they are naturally anxious to guard their own interests. And it is the lack of sense to understand even the elementary principles

of economy and methods of business that has crippled what few industries were even left in the hands of our countrymen. Our youths who proceed to foreign countries for learning industries must, therefore, properly realise their awkward situation and go prepared to put up with all sorts of troubles and difficulties. There is, however, a strong ray of hope and it lies in the transference of a great part of the treasures of art and industries from human hearts to printed books. As long as these secrets were locked in the artificers' hearts, there was very little chance of our getting at them, but by their publication the way has become much easy, and if our students can pick up even the rudiments of industrial knowledge, they would be able to greatly expand and improve the same by an intelligent study of books dealing with those subjects. Unfortunately, however, much of the literature on glass manufacture is in continental languages of Europe which our men cannot ordinarily understand.

There appears to be a tendency at present to send boys fresh from colleges. They usually get no commercial education before they go and while their advanced literary (non-industrial) education enables them to learn the technical portion of industries tolerably well, the business or commercial aspects of the same (*viz.*, their adaptability to the Indian soil and resources as well as to the tastes and conditions of our people) remain in a great part unstudied, and on their return home they cannot turn their knowledge to full advantage. Many a concern has come to grief in India because its conduct happened to lay in the hands of intellects that were commercially inefficient and on principles that were economically unsound.

It would be well for us to remember that in these days of commercial ascendancy the extent of a country's progress in the scale of international civilisation is greatly measured by its wealth-growing capabilities. We are in the midst of critical times and our country has become an exploiting market for all other enterprising nations of the world. Our hardest battles will, therefore, have now to be fought in the domain of commerce and industries. The nation that has now outlived terrible adversities and great trials for thousands of years will succumb to this latest calamity unless the entire population struggle hard to attain commercial supremacy in our own markets if

not in the markets of other countries as well. Starved and emasculated, the vitality and resisting forces of our nation are fast diminishing and we must make a tremendous effort to equip ourselves with the requisite energy and enterprise to supply all, and every one, of our wants by articles of local manufacture. It is evident that no endeavours for the up-building of our nation can ever be perfect or successful unless and until we at the same time set right the economical condition of our country by tapping its industrial resources and keeping our wealth within the land.

I cannot better conclude this paper than by quoting Dr. Johnson's description in the pages of the *Rambler* about the fine vistas of progress and comfort opened to humanity by the introduction and use of glass articles, as also of the unpromising beginnings from which most useful productions of art at times arise:—

“Who, when he first saw the sand and ashes by casual intensesness of heat melted into a metalline form, rugged with excrescences and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world? Yet, by some such fortuitous liquefaction was mankind taught to procure a body at once in a high degree solid and transparent, which might admit the light of the sun and exclude the violence of the wind, which might extend the sight of the philosopher to new ranges of existence, and charm him at one time with the unbounded extent of material creation, and, at another, with the endless subordination of animal life, and, what is yet of more importance, might supply the decay of nature and succour old age with subsidiary sight.”

“Thus,” continues Johnson in his own grand and mellifluous style of expression, “was the first artificer of glass employed, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyments of light, enlarging the avenues of science and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature and the beauty to behold herself.”

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## CO-OPERATIVE CREDIT SOCIETIES.

MR. K. C. DEY, M. A., I.C.S.,

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FOR many years the chronic indebtedness of the agriculturists in India, leading to their utter ruin in not a few cases, has been attracting the serious attention of the Government of India, and many enquiries were instituted with a view to devise means of alleviating their distress. Different experimental measures were adopted in some provinces and after a great deal of deliberation, the Government adopted the institution of Co-operative Credit Societies as one of the remedies of this great evil. In 1904, an Act was passed in the Supreme Council called the Co-operative Credit Societies Act (X of 1904). And although two years have passed it is to be regretted that the provisions of this Act, and the various concessions and facilities granted to the Co-operative Credit Societies by Government are still unknown to the great mass of the people.

2. It is known to all conversant with the agricultural villages in this country, how the common cultivator lives in debt, year in and year out, and is only too often ruined entirely by the *mahajan*. In many parts of the country the actual cultivator of the soil has gradually lost all permanent interest in the land he cultivates and has become either a labourer working for wages or only a *bargadar* or an *adhidar*, a yearly tenant who gets half the produce or less as wages. In a great many cases has the original cultivating lease been acquired by the middleman who does not till the soil himself but lives on the produce of the toil of the rack-rented sub-tenants or ill-paid labourers. In the districts of Eastern Bengal, the subinfeudation of the tenures has become notoriously vast and complicated, and all over the province the cultivator seldom gets the full benefit of his labour and the fertility of the soil. In most cases the cultivator is deeply in debt to the *mahajan* and can hardly hope to ever get out of his clutches. At harvests, he is compelled, in a great many cases, to sell his produce to the *mahajan* at the *mahajan's* rate and is cheated only too often in the weighing as well as in the

rate. The bulk of the money he earns goes to pay the rent and the too heavy interest on his former loans. Between harvests the poor man has to borrow again for the necessities of life, and this hopeless cycle of heavy borrowings and meagre repayments plunges him deeper and deeper in debt.

3. Nor is the case of the poor artisan in the villages any better. The weaver, the boat-builder, the blacksmith are all in the same state of chronic indebtedness. For the purchase of raw materials the artisan has to borrow, and so pressing is the demand of the *mahajan*, that he is compelled to sell off his manufactured produce at once at what price he can get, too often to the *mahajan* himself. He has to borrow for his food and his clothing, for the payment of rent, for every necessity and luxury of life. Thus his ceaseless labour does not benefit him much and only serves to enrich his *mahajan*.

4. The fact is, that for agriculture and petty industries, the cultivator or the labourer in the villages possesses no capital of his own. He has money to buy land, cattle, implements, of raw materials and he has no money to supply him with the necessities of life till he can sell his produce in the best market. He has to borrow his capital and he borrows it at an exorbitant rate, and too often he cannot get sufficient capital for his needs. Sir D. M. Hamilton, a former President of the Bengal Chamber of Commerce, expressed these circumstances very tersely. He said that one must buy one's finance cheap and sell one's produce dear, to make one's industry profitable, but the Indian cultivator buys his finance dear and sells his produce cheap and the consequence is that he is imposed on at both ends and lives in poverty with scarcely any hope of bettering his position.

5. The reason for this deplorable state of affairs is to be found in the villager's want of thrift. He never knows how to save money, and as his income is chiefly derived from one or two harvests, he cannot make the money obtained by sale of the produce last the long intervals between them. Want of training how to save and put by, the hereditary instincts and customs of extravagance at weddings and other ceremonials and, above all, the want of a safe place where to keep the savings—all these contribute to the absence of thrift among the poor in our country. When the man is able by hard work to save a few rupees, he



knows not where to keep it safe. He generally buries it under the ground where it lies unproductive for years—and he is too often robbed by the thieves, or dies without being able to tell anyone where the hoard is concealed.

6. Again, the capital available for financing these people in the villages is not considerable. The *mahajans* very often are poor men themselves, dependent on the profits of their usury for their own maintenance. While a rich man can easily obtain loans of thousands of rupees in a city at 6 to 8 per cent., the poor man in the village cannot obtain accommodation of ten or twenty rupees at less than  $37\frac{1}{2}$  per cent., although the security he offers is no less sound than that of the rich man. The prevailing rate of interest at which a villager borrows money in this country is  $37\frac{1}{2}$  per cent. per annum, or two pice per rupee per month. In some parts of the country, the rate rises so high as 75 per cent., and not seldom have I come across rates of interest at 150 per cent. per annum.

7. Thus it will be seen that the problem before us is as vast and complicated as difficult of solution. No amount of State aid or philanthropic help can be of much effect, for obviously it would be no use paying off the poor people's debt unless they are taught not to fall into it again. Capital has to be provided in sufficient quantity to free the agriculturists from the existing debts at usurious interest and then to supply funds for the purchase of implements, cattle, seed, labour and raw materials, and also for maintenance till the produce can be sold in the most advantageous market. This capital has then to be made available to the people for whom it is intended, with security to the capitalist—and facility and safety to the borrower. The credit thus afforded should then be safeguarded from possible abuse and means must be devised to secure that no credit is given to undeserving persons or for undeserving purposes, and that the loans given to deserving persons are employed on useful and necessary purposes. The capital should not only be brought near the houses of the people but should be made available at a rate of interest which will leave a fair margin of profit to the individual who employs it. Lastly, the individual must be taught thrift, the habit of saving encouraged, and a safe place provided for the custody of the savings. The villagers have to be taught habits of business and reliance

on their own selves, for any extraneous agency to work the capital must fail. One of the solutions that has been found by Government satisfying all these requirements, is the Co-operative Credit Society.

8. A Co-operative Credit Society is primarily a society composed of a number of persons who co-operate or combine their credit together for the purpose of obtaining cheap and facile financial accommodation for themselves or, in other words, it is a joint-stock bank, the capital of which is subscribed by the members themselves or is borrowed on their joint credit and is employed only on loans to themselves. A single villager cannot get a loan except at a very high rate of interest, and he cannot successfully approach a wealthy capitalist or a joint-stock bank who deals in hundreds of rupees and will not deal in small sums. But if a number of villagers of good and honest reputation form a credit society, and agree jointly and severally to stand security for all the debts of the society, then the society can approach the larger capitalist and obtain a lump sum as loan at a small rate of interest. Even the smaller capitalists, the local money-lenders, will recognise the advantages of lending a large sum to one body, and will be satisfied with the smaller profit and reduce their rate of interest. From the lender's point of view, the co-operative Credit Societies will offer excellent investment. The security is good, as the joint and unlimited liability of a large number of people is pledged. One or two of the members may fail, but the others remain and the likelihood of the security proving useless is reduced to a minimum. Instead of a large number of petty accounts to keep, only one account need be kept for one village. Instead of having to collect little sums from a large number of poor people, regular instalments from a well-ordered society will be collected with punctuality and ease. Instead of incurring large expenses and suffering great worry, trouble and much loss of time in suing many petty debtors, only one suit, if ever necessary, will have to be instituted against one corporation and the security being so ample the decree will be even more easily executed than against any individual debtor. It is certain that, in most places, as soon as the people understand the principles, the capital for these societies will be forthcoming. For it must be remembered

that, though all men are not philanthropists, they are not all usurers: There are thousands of people whose money is locked up in Post Office Savings Banks or in Government securities, bearing interest at 3 or  $3\frac{1}{2}$  per cent., who will be glad to invest at least part of their savings in the Co-operative Credit Societies at 6 or  $6\frac{1}{4}$  per cent., if their security and advantages are made known. The societies already established have got all that they require at present at 6 to  $6\frac{1}{4}$  per cent., and two societies have actually refused to accept offers of large loans at these rates, as the money was not needed by the members.

9. The societies will also be capital savings banks for the members. The societies will never refuse to accept deposits from members. Whatsoever money a member may save can be safely deposited with the society, and the society will give him a very fair interest, say 6 or  $6\frac{1}{4}$  per cent. per annum. When a cultivator sells his jute or mustard seed or sugarcane, he pays his rent and then either squanders the remainder in purchasing unnecessary luxuries, or buries it under the ground. Sometimes he starts money-lending on his own account and often loses his money by injudicious loans. But if he deposits his money in the society, the society will pay him a fair interest regularly and will carefully invest the money for the benefit of his fellow-members. When the cultivator understands this, he will learn to save and deposit his money regularly. In some societies, there is a rule of compulsory saving, each member being required to deposit after each harvest a certain amount proportionate to his land or to the number of ploughs he keeps. The Government has offered, as an additional incentive to thrift, to lend to Co-operative Credit Societies a sum equal to what the members raise by their deposits free from interest for three years and thereafter bearing interest at only 4 per cent. per annum.

10 With the capital obtained from deposits of members, loans from Government and borrowings from the large or small capitalist, the societies will have enough funds to work with. The capital, however, will be employed only for issue as loans to members and for no other purpose whatsoever. The loans shall be given to members only and to no others. Loans will be given out carefully, for the actual needs of the borrower and not for the purpose of squandering on unnecessary luxuries

or evil purposes or for re-lending to others. Neither the law nor the bye-laws will in any way limit the purposes for which the loans may be granted. But it is left to the good sense of the members themselves to grant or withhold any loan. Each member will remember that he is personally liable for the whole of the capital of the society and thus every member will naturally strive to prevent the giving out of loans on insufficient security or for undeserving purposes. Loans will be granted for all productive purposes, for maintenance, for payment of rent, for repayment of older debts and for the absolutely necessary expenditure on marriages and other ceremonial occasions. No one except the members themselves know accurately whether a man really requires a loan or not, and how much he requires for his needs. A loan for a purpose approved of by the members is sure to be granted, and it is almost equally sure that it will be usefully employed. As the lenders are co-villagers, the borrower's own people, there would be great facility and expedition in obtaining the loans and as in a village, it is scarcely possible for an individual to keep his affairs secret from the fellow-villagers, it will not be difficult to ensure that each loan is employed on the purpose for which it was intended. Again the members will know the circumstances of each applicant exactly and will thus decide in a way satisfactory to the applicant as well as to the society when and by what instalments the loan is to be repaid. If the borrower has got jute and mustard cultivation, the loan will be made repayable after the jute and the mustard harvests. If he has paddy and sugarcane the loan will be repayable after the paddy and the sugarcane are sold. Loans thus carefully granted for actual needs and on suitable terms will be to the immense benefit of the borrower and safe investment to the society.

11. The law does not fix the rate of interest payable on loans. The authority is vested by the bye-laws in the members themselves. They are to fix the rates of interest payable to the society on loans issued as well as that payable by the society on deposits and borrowing for each year. The rates will depend on local circumstances. The rates will vary not only in different societies, but in the same society from year to year. If there is a heavy loss one year, the rate of interest payable to the society will be raised and

that payable by it to the members on deposits lowered until the loss is recouped. If there is general distress in the village, the rate payable to the society will be lowered. The rate of interest payable by the society on outside capital will depend entirely on the credit of the society and the capital available in the locality. But for the purpose of creating a reserve, the rate charged by the society must be slightly above the rate payable by it. If capital is obtainable at  $6\frac{1}{4}$  per cent., the rate on loans may be fixed at  $9\frac{3}{8}$  or  $12\frac{1}{2}$  per cent., the excess being kept for the purpose of creating a reserve. The members who deposit their savings get a fair interest on their money and on the rest of the capital raised, proper interest is paid, so all the profit that the society makes by lending at a certain rate money obtained at a lower rate, will go to what is known as the Reserve Fund.

12. The purpose of the Reserve Fund is three-fold. If there is ever any loss or remission, the Reserve Fund will bear it. But if members are chosen with care, and fraudulent, dishonourable, bankrupt and spendthrift people are kept out of the society and if loans are granted with due caution, there is no likelihood of any loss ever accruing. Up to date, there has not been any loss in society established in this province or in any other province in India. In Germany, where this system has been tried with immense success for over 50 years, "not a pfening has ever been lost either to creditor or to depositor." So in France, "not a sous has been lost," and in Italy "the losses have altogether been trifling; in times of economic crises less than those of other banks." The next purpose is for the creation of additional credit. If the society can show that it has so much money kept safe as a reserve, the capitalists will be much more willing to invest their money in the society than otherwise. A reserve of cash is so much more easy to realise than even the whole of the landed property of all the villagers. Lastly, as the Reserve increases, there will be less and less necessity for the society to make profit, and the rate of interest payable on loans issued by the society will be gradually reduced. When the Reserve reaches a certain amount, safe enough for the society, all profits since accruing will be used as capital, and less money will have to be borrowed and the rate of interest payable on borrowings will be reduced to a minimum. Eventually, it is expected that

the societies will work with the capital consisting of their own profits and the deposits of the members, and the members will be enabled to get loans at so low a rate of interest as 3½ per cent. The Reserve Fund will, at all times, be indivisible among the members. But if a society is ever closed or wound up, the balance remaining out of the funds, after payment of all liabilities, will be employed on such useful public purpose as the members may decide. The provision is necessary to prevent the members being ever tempted to close the society for the purpose of dividing the accumulated profits among themselves.

13. The loans will be given to the members only, and as all the members and their circumstances, position and income are quite well known to all other members, the security required will not be prohibitive. In many cases, no security of any kind will be necessary. In many others, the personal security of a brother member will be sufficient. In some cases it may be found necessary to accept security of landed property. But these cases will be rare. In no case, however, movable property should be taken as security, for the difficulties of testing and custody are in most rural places insuperable and the chances of the society being imposed on are very great.

14. If the members are chosen with care, and if they are honest even if they are very poor, there is no chance of any loan being lost. The other members, when they realise that they are each and every one responsible for the whole of the capital of the society, will see that the borrower pays up his dues in time. If, owing to circumstances beyond his control, a borrower cannot pay up dues in time, his brother members, knowing the reason for default, will give him time to pay up and in extreme cases may even remit the debt. But the brother members are sure to know if the borrower defaults purposely when he is able to pay, when not only will they at once sue him for the debt and pursue the suit to the bitter end, but levy a penal interest and remove the fraudulent borrower from the benefits of the society. No special summary procedure has been prescribed for recovering loans from members, as such concession is liable to abuse and is likely to scare the less intelligent cultivators. But it is extremely unlikely that, if the members do their duty, a suit will ever be necessary. In no case has a suit ever been brought by any society in this province or

in any other. As a matter of fact, members must be chosen with such care that no loan may be lost, and the loans should be given with such circumspection and the conditions of repayment made in such a way that no default will be probable.

15. To encourage the formation of these societies and help them to get on, as well as to simplify their proceedings, the Government of India has granted several concessions. I have mentioned before the generous terms on which advances will be granted by Government to the societies. Besides this, all deeds executed by or in favour of the society are exempted from the payment of stamp duty. When documents by or in favour of the society are registered, the registration fees are remitted. The income-tax on all profits by the society or by its members in dealing with the society is remitted. There is no fee charged by Government for the registration or incorporation of the society, and the stamp duty on the Articles of Association is remitted. The accounts of the societies are audited by the Registrar once every year free of charge, and his advice is always at the service of the society. The Post Office Savings Bank, which is not open to any other companies, has been opened to these societies for the safe custody of their money, and the conditions of such custody are more convenient than those for private persons. Besides the absolute safety, there is another advantage in such custody, namely, that all the surplus funds of the society earn interest at 3 per cent. per annum so long as they remain in the Post Office Savings Bank. According to the Rules made by our Government, any entry in the books of account of any society can be proved in any court of law by the production of a copy of the entry certified to be true by the Chairman. No officer of Government, except the Registrar and the Collector or any person specially authorised by the Registrar or the Collector, is empowered to inspect the societies, so that there is no fear of undue interference of the petty officials of Government. The restrictions and obligations imposed on the joint-stock companies by the Indian Companies Act are not applicable to those societies. Extreme latitude is given to them in the making of their own bye-laws, including rules of procedure, in fixing the rates of interest to be levied and paid and in all matters of internal administration. The money due to a member is paid after his death to any person whom he nominates in

accordance to the rules, so that the heirs of members are spared the cost, delay and trouble of obtaining a succession certificate.

16. The Act also provides for the formation of Co-operative Credit Societies for the assistance of the needy people who are not agriculturists or who are not residents of villages. These societies are called urban societies, while those described in the preceding paragraphs are called rural societies. In a rural society at least four-fifths of the members must be agriculturists, and in the urban societies at least four-fifths of the members must be non-agriculturists. There is another important difference between these societies. Whereas the liability of the members of rural societies should almost always be unlimited, in urban societies it may be limited or unlimited. Usually we find that the residents of the towns have not all their property situated within the town, nor are their circumstances and dealings known to each other so well as in the villages. Hence, in many cases, it is difficult to find men in towns who would be willing to co-operate their credit on the basis of unlimited liability, or, in other words, take on themselves the responsibilities of the debts of others. The liability of the members of the society can, however, be limited to the amount of the share held by each. The capital of a society of limited liability is derived chiefly from the value of the shares subscribed by the members. The shares are usually of small instalments at sufficiently long intervals. Every member must own at least one share, and no member can hold more than one-fifth of the total number of shares, nor shares representing a nominal value of over one thousand rupees. The shares are not heritable, but the value of the share is paid to the nominee of the member after his death, like all other dues. When any person ceases to be a member of the society, the value of the share is refunded to him. The shares are not transferable except with the permission of the society and even then only to another member of the society. One-fourth of the profits of an urban society goes into the Reserve Fund, and the balance is paid to the members as dividend on the shares. In all other respects the urban societies are similar to rural societies. These societies will much benefit the petty artisans, such as weavers, the petty tradesmen, the lowly-paid clerks and the smaller professional men who work in towns. In many cases, it is likely that these societies will, after supplying the needs of



their members, have some surplus money in hand. The law provides for the employment of such sums in financing the rural societies in the neighbourhood.

17. I have dwelt on the economic advantages of the system of co-operation in these credit societies. But this is not all the good that comes from them. Wherever these societies have worked with success, "a new world has been called into existence to redress the balance of the old." I look forward with hope to the time when these societies will work wonders in elevating the social and the moral tone of the village communities in this province besides providing and organising the village finance. The time will come when the people of a village, who in former times used to take scarcely any interest in anything outside their own threshold, who used to spend their scanty savings in extravagance, litigation or purchase of unnecessary articles of luxury or to hoard them profitlessly will learn how to save and employ the surplus funds for their own profit and for the benefit of the fellow-villagers. It will create "a new world—a world of brotherly love and mutual help, where every one is the protector and assistor of his neighbour." The principles underlying credit and trust will infuse a new spirit in the careless and thriftless villager and kindle in him the desire for standing well in the eyes of his neighbours. One may hope that, as in other countries, under the influence of these societies, the idle man will become industrious, the spendthrift thrifty, the drunkard will reform his ways and become sober and the illiterate will learn to read and write."

18. It will no doubt take a good long time before we can attain the stage of such perfection. The movement is still in the experimental stage in our country and has scarcely taken a firm root. We require the active co-operation of the intelligent and educated community to make Co-operative Credit Societies a common national institution in every village, a luxurious growth spreading into the remotest corners of the empire. I cannot over-estimate the immense educative results of these noble organisations which the Government has given the first impetus to and which I sincerely hope will throw open the door of renewed national prosperity. I appeal to every one of my countrymen to assist and encourage this cause with his co-operation in work and in means within his own sphere of influence.

# A CENTRAL BANK TO FINANCE CO-OPERATIVE CREDIT SOCIETIES.

MR. K. C. DEY, I.C.S.,

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IN another paper, which I had the privilege of reading before this Conference, I have described what Co-operative Credit Societies are, what they purport to do, and the methods of their working. Co-operative Credit Societies are institutions for the purpose of conserving the wealth of the country and employing that wealth to the greatest advantage to the people of the country. The movement to introduce these institutions in our country ought, therefore, to receive the earnest sympathy and assistance of all people who have the good of their country at heart.

2. These institutions are primarily the associations of the men of limited means, who cannot, under the existing circumstances, command sufficient capital for their needs, or obtain it with sufficient facility or at sufficiently moderate rates. They are meant to finance the cultivators and weavers and other artisans in the villages and the small tradesmen, petty dealers and other people of limited means in the cities. The primary idea is that, when these people band themselves together in a Co-operative Association with unlimited liability, that is, pledge all that they own and jointly and severally undertake the responsibility of the whole of the liability of the Association, they create for themselves a collective credit far in excess of the sum of the individual credit of the members. Theoretically such Associations ought to be able to command in this way capital sufficient for the actual needs of all the members at a sufficiently moderate rate of interest, and in the ideal stage, they are expected to fulfil their highest ambition—"every man his own banker."

3. The difficulty in this country in the popularising of such institutions consists firstly in making the people of small credit

who are proposed to be benefited, understand the enormous advantages of co-operation and agree to join the Association with unlimited liability. But this difficulty is not insuperable, and wherever an attempt has been made in any rural area, and the entire internal administration of the affairs of the society is vested in the people themselves, the fears of unlimited liability have vanished and people have come forward to form societies. For, in these rural areas, the people know each other and the material circumstances of each other very well, and if the right of selection of the members and the right of deciding the terms and conditions of the loans issued are left entirely in their own hands, there is never any fear of any loss, the conditions of unlimited liability present no terrors and the responsibility of the whole liability makes them only more careful in their transactions. This has been the experience not only in the Province of Eastern Bengal and Assam, but all over India, and the very rapid increase in the number and the membership of these societies all over the country proves that, where properly taught, the Indian agriculturists are not backward in appreciating and taking advantage of the principles of co-operation as applied to credit.

4. The second difficulty in the formation of a large number of these societies lies in the financing. The members of these societies, are men of limited means, and they join the society primarily for the purpose of borrowing. It is seldom that they have money to deposit, sufficient to meet the needs of all the members. Such of the richer villagers as do join the society not for the purpose of immediately taking loans but for the purpose of doing so if circumstances ever require, cannot or will not deposit all their savings in the society. For, although, having the right of selection of members and control over loans in their own hands, they do not hesitate to undertake the unlimited liability, yet they are habitually conservative in thought and action and are reluctant to put all their savings in an institution, which, though entirely managed by them, is quite new and beyond the sphere of their knowledge and experience. It has been found in the actual working of these societies that the deposit of the members amounts to very little in the beginning, but it steadily increases as the society grows older and the deposits are invariably put back into the society when the

period of the first instalment expires. The confidence of the members increases as they see that society working wisely and with profit to itself and benefit to the members themselves. But in the very beginning it is hard to raise sufficient capital from the village itself. There is no society in the Province of Eastern Bengal and Assam which has begun solely with its own capital. All the societies have taken loans from Government, but as these loans cannot exceed the amount which the members deposit themselves, they have not very materially helped in increasing the funds. In almost every case, the societies have had recourse to outside help in the shape of loans from or deposits by non-members, such as educated philanthropic neighbours or Zamindars.

5. In order to facilitate the formation of new societies and finance those already established, one of the remedies that has been attempted in some Provinces is the formation of Joint Stock Banks to lend money solely to Co-operative Credit Societies. The capital of the Banks is raised in the very beginning by shares taken by its constituents and then as occasion requires by the issue of debentures on the security of the unpaid share capital and the Reserve Fund. The Banks are Joint Stock Companies with limited liability, but they are registered under section 6 of the Co-operative Credit Societies Act (X of 1904), and thus obtained all the privileges and concessions granted to Co-operative Credit Societies. These Banks, like other Joint Stock Banks, are managed by Directors elected by the shareholders. The funds of the Banks are employed in giving loans to the existing or newly-formed small Co-operative Credit Societies in the interior. The risk of loss in these Societies is minimised by wise provisions which are fully described in my paper on Co-operative Credit Societies. The risk of loss to the Central Banks is thus also reduced considerably. Instead of individuals lending money to individual societies, they take shares in or buy debentures from the Joint Stock Central Banks, which deal with the individual societies. The risk of loss to the investor will thus be as little as possible.

6. There are many such District and Central Banks in the United Provinces of Agra and Oudh, some of them with capital exceeding a lakh of rupees, which are financing hundreds

of smaller Banks. In the Cities of Bombay and Madras, such Banks have been recently established and promise to work very successfully. In the Province of Eastern Bengal and Assam, there is already one such Bank which, besides accommodating its members, is financing the rural Co-operative Credit Societies established in the district and another such Bank on a slightly larger scale has been recently established. But the Banks in this Province are of extremely limited resources and they have not much scope for extensive work, and a large Provincial Bank on the model of those of other Provinces will be of much assistance.

7. I do not intend to take up the time of the Conference with a detailed description of the methods on which the existing Central and District Banks are working or the way in which these Banks may work, but I only wish here to submit this scheme in the briefest possible terms. If the idea takes root in the minds of the thinking public, I shall be ready to place before them all the information I can furnish, and my services will be at their disposal in any way in which I can further the working out of this idea.



## INDIAN ESSENTIAL OILS.

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IN introducing to the Indian Industrial Conference the subject of perfumes, one is struck by the fact that so little has been previously written on the subject. India, as an Eastern and tropical country, is renowned all the world over for its odoriferous species and perfumed blossoms, the essences of which have been extracted by recondite methods for ages past. The sources, uses and preparation of these ancient drugs is a highly interesting historic study and would be out of place to discuss here. I referred to this aspect of the subject about two years ago in an article on "The Perfumes of the Moghuls" (*Calcutta Review*, Oct., 1904). On the present occasion it will be my aim to indicate the geographical and botanical sources of the chief commercial essential oils, review the present condition of the trade, and make a few practical suggestions in passing on the future possibilities of the industry.

Essential oils are distinguished by their strong and characteristic odours, and by being evaporated without decomposition and with little or no residue. The composition of essential oils is variable; many, like turpentine oil, consist of carbon and hydrogen only, others contain oxygen in addition. Their chemical constitution also differs in different cases, the majority being ethereal salts or compound ethers, aldehydes or phenols. Many essential oils consist of hydrocarbons or fluid bodies, mixed with solid oxidised compounds. When the latter are present in considerable amount, a portion usually separates out in a crystalline form. In such cases the solid is often referred to as the *stearoptene* and the liquid is called the *elaeoptene*. The essential oils are almost all of vegetable origin and exist in the flowers (as the rose), in the leaves (as the basil), in the rind of fruit (as the orange), and the fruits of the umbelliferæ (as the anis and ajwajn).

The extraction of the oils is performed by the following methods, but in India the first only is that in general use.

1. Distillation of plants or parts of plants by boiling with water and condensing the steam. Notwithstanding that nearly all essential oils boil at a higher temperature than water, their vapours escape with the vapour of water and collect in the distillate where they separate. Another modification of this method is to employ steam instead of a naked fire, this prevents the caking and burning of the solid matter at the bottom of the still.

2. The process of the sponge and the ecuelle. In the case of fruits of the orange tribe, in which the oil glands are large and numerous, a portion of the essence can be extracted without distillation. For this purpose either a sponge, or a vessel like a cup with sharp points inside, is used for separating the oil from the peel.

3. *Expression*.—In a few cases (orange, lemon, &c.), a part of the essential oil may be obtained by submitting the material to pressure.

4. *Maceration in fat*.—This is to avoid, as much as possible, the application of heat. The flowers are macerated in vegetable tallow or paraffin, previously melted on a water-bath. The fat, charged with the essence, is afterwards shaken up with alcohol which removes the perfume.

5. *Enfleurage* or absorption is another process having the same object. Here layer of fat on glass frames are covered with flowers, and the flowers changed each day until the fat is sufficiently impregnated with the perfume.

For the purpose of illustrating the trade in Indian essential oils, I have prepared a diagram showing the value of the exports for the past twenty-seven years. In 1879 the exports were valued at Rs. 1,20,439, they rose in 1902-3 to Rs. 7,70,872, and have remained at a high figure since then. On consulting the table it will be seen that there are two serious depressions, one occurring in 1896-97, and the other in 1900-01. It will be remembered that these periods coincided with two disastrous famines which were particularly felt in the Central Provinces, the region of the grass oil industry. The famine of 1896-97 affected the Khandesh District, and naturally resulted in short supplies of the oil. In 1899-1900 the famine of the Central Provinces was worse in the western provinces of Nimar and Betul. In Nimar the death-rate reached the melancholy height of 105 per mille. The exceptional drought decimat-

ed the plants just at the season of distillation and for some months that year the Bombay dealers received no stocks. This scarcity not only affected the trade in India but also caused great inconvenience in the European markets, the price had to be raised, and the door was opened to smaller dealers to resort to adulteration. The monsoon that burst in July, immediately after the famine, was very heavy, and the young grass suffered in consequence, but in 1901 and 1902 the industry recovered itself as will be shown in the table. In studying the essential oil industry in India, where the occupation is chiefly in the open air, one has thus to reckon with drought, floods, frost and other adverse climatic conditions which, in certain seasons, give the trade a 'setback.'

After these general remarks on the Indian trade as a whole, I propose to refer to the various perfume plants which afford commercial oils and specify a few others which might be rendered to some account as trade articles in the future.

One of the most important essential oils in this country is East Indian geranium or palma rosa oil. It is known in the vernacular as *rusa-ka-tel*, and is referred to in ancient work on perfumes and medicines. The oil is obtained from a grass—*andropogon schoenanthus*—or rusa grass which is widely distributed in India. This grass is abundant in the north-east of the Bombay Presidency, in Malwa, Merwara and Rajputana in Central India, and in the Central Provinces and Berar. The art of distilling the essential oil from the grass was probably commenced in Khandesh in the 18th century when this district was in a flourishing condition under its Muhammadan rulers. The original seat of the industry appears to have been at Pimpalnur, but as the oil became in greater request, the manufacture spread to Nandubar, Shahada and Taloda. The Nimar District in the Central Provinces has always been an important centre, so much so that the oil was for many years known commercially as 'Nimar Oil.' It was first brought to the notice of Europeans by Dr. Maxwell in 1825, and Mr. J. Forsyth, in 1827, was the first to make an inquiry into the industry. He found the grass in patches in the jungles throughout Nimar and the Nerbudda Valley, but in greater abundance along the foot of the Vindhyan range in the vicinity of Jaun ghat, and 30 miles further west on the table land near Nalcha. The plant



commences to flower at the end of August and continues to flower vigorously to October and November and during this time it gives sufficient oil to cover the expenses of its preparation. The distillation was conducted eighty years ago according to the same methods in use at the present day. The grass is boiled with water in wrought iron stills fitted over an earthen fireplace. From the still-head two straight tubes, from 5 to 6 feet long, conduct the vapours into two copper receivers immersed in cold water. The process occupies about six hours, and as four boilings are made in 24 hours, a seer of oil can be obtained in that time. One of these stills will produce one and a half maunds or 80 quarts of oil during the season. We have no computation of the number of stills employed at the present time, but in 1879-80 there were 197 stills producing 71 cwts. of oil in West Khandesh and 100 of these were in Nandurbar alone.

Within the last few years there has been a considerable expansion of the industry in the Central Provinces and Berar. In the Forest Administration Report for 1896-97 the distillation was observed to be extending in Nimar District, and was carried on also in Hoshangabad, Betul, Mandla and Seoni. The forest revenue from the grass became an important consideration; in 1901-02 in the Betul District the receipts from leasing *rusa grass* lands went up from Rs. 1,325 to Rs. 7,332. Lately other districts have shown a revenue of over Rs. 10,000 per annum for leasing *rusa grass* lands.

In Berar the distillation is carried on in Ellichpur, Amraoti, Buldana, Basim and Wun. Jamod in Akola has been said to be celebrated for the industry. The oil prepared in various localities in Berar is brought to the chief market at Ellichpur town where it is brought up by dealers and exported to Bombay at Rs. 2 to Rs. 4 per pound according to quality. The grass is everywhere very abundant, and the distillation requires only a moderate amount of skill and a small initial capital. The manufacturer is, therefore, well recompensed for his labour which is shown by the late increase in outturn and proved by experiments made by the Forest Department in 1902-03.

There are two kinds of *rusa grass* oil obtained in the Central Provinces, one of a fine delicate odour and yellow colour called "Motia," and the other darker and more pungent called "Sophia." Ordinary *rusa* oil has for its principal constituent an

alcohol boiling at  $232^{\circ}$ , named geraniol. The amount of this constituent varies from 76 to 93 per cent. Rusa oil is soluble in three or more parts of 70 per cent. alcohol. It was formerly adulterated with ground-nut oil, but as this is readily detected it was afterwards adulterated with kerosine and turpentine oil. The dealers have lately given up the suicidal policy of sophistication, and export the oil as it comes from the distillers. A very simple test for this and all other essential oils is to place a drop or two on a piece of white blotting paper and heat it. If volatile oils are present no stain will be left, but in the case of fixed oils, like ground nut or castor, there will be a greasy stain. The only satisfactory method of testing an essential oil is to ascertain the boiling point, and to separate the constituents by fractional distillation, and separation of its alcohol by potassium sulphite, and other chemical methods.

Rusa grass oil was formerly designated Turkish geranium oil in the time when the oil entered the European market by way of Constantinople where it was used on a large scale for mixing with otto of roses. It is used by the Arabs and Turks in making hair oil, but it is most extensively employed in soap manufacture and perfumery.

*Exports of Essential Oils (chiefly Rusa-grass oil) from Bombay.*

	Gallons.	Rs.
1896-97 ..	8,199	1,49,553
1897-98 ..	10,776	2,09,691
1898-99 ..	16,000	4,04,140
1899-1900 ..	10,400	2,78,005
1900-01 ..	12,834	3,44,670
1901-02 ..	19,641	6,10,783
1902-03 ..	18,872	5,23,630
1903-04 ..	20,680	5,38,774
1904-05 ..	18,742	4,65,209
1905-06 ..	23,436	5,51,425

These figures reveal a five-fold increase during the past forty years, for in 1866-67 we find that 41,643 lbs. (4,627 gals.) were shipped from Bombay to England and ports of the Red Sea. About ten years ago Egypt, the United Kingdom and Turkey in Europe were the principal consumers; at the present time, while Egypt is still absorbing one-third of the exports, Germany and France have become important buyers.

In former years, as we have shown, East Indian geranium oil always varied in composition and properties, it appeared to be made from a mixture of grasses and it was often adulterated with other oily products. Within recent years the situation has changed, and an excellent oil at moderate prices is in the market. It has acquired a distinct reputation in the perfumery industry, and is considered a good material for scenting soaps.

From a commercial point of view a critical stage has been reached. The production of the oil has grown in an unprecedented manner, and large parcels of good and medium oil are being regularly thrown on the market. The price last year had never before reached such a low quotation, and large supplies this year are threatening still further to depress its value. In consequence of these favourable conditions to purchasers on the Continent, the manufacture of geraniol on a large scale has been taken up and this added to its cheapness will cause other outlets to be invented for its use as a natural or artificial perfume.

Besides India, Europe receives fair quantities of geranium oil from Algeria and Reunion, and the Spanish oil in point of quality is not approached by any other kind. The production in Algeria is estimated at 207 cwt., and at least 1,250 acres of grass are under cultivation. From Reunion the average exports of oil have been 250 cwts. Notwithstanding this competition, India in the matter of quantity is far in advance of any other country in the production of this perfume.

Lemon-grass oil is another grass oil derived from a species of *Andropogon* usually referred to as *A. citratus*. Although allied to rusa grass oil in its botanical origin, it is totally distinct in its chemical composition. Lemon grass oil, as its name signifies, has a lemon-like odour and taste. It is a yellowish or reddish liquid of sp. gr. 0.899 and 0.903. It is readily soluble in 2 pts. of alcohol of 70 per cent. The chief constituent is an aldehyde, citral boiling at 228°, which occurs in the oil to the extent of 70 to 75 per cent. Citral is also found in lemon peel, the leaves of the true verbena of Spain, and in other lemon-smelling plants.

Lemon grass oil is prepared in Southern India, and the industry is more modern than that of rusa oil. I can find no earlier record than its importation into England in 1832. For many years it has been prepared on the western slopes of

Travancore north of Anjengo as far as Cochin, where the grass can be obtained sufficiently green and fresh for about six months in the year. In this region the Malayalis distil the grass in copper stills with an earthen dome and the condenser consists of a copper tube passing through a tall wooden bucket. Each boiling yields a quart of oil worth about Rs. 3 in the bazaar. In the eastern part of the Travancore State, the Tamils use a round copper boiler contracted into a neck at the top and about four feet high. The top is covered with a specially prepared earthen vessel which communicates with a copper tube about three inches in diameter which passes through a condenser filled with cold water to a receiving vessel. When the still is charged with grass, all the joints are made air tight by luting with rags and clay. Distillation is continued for twenty-four hours when about a pint of oil is obtained. The stills are moved about from place to place according to the abundance of the grass, and in the cold weather may be seen dotted over the landscape. In February the grass becomes coarse and is burnt. The industry and the profits were formerly in the hands of natives, and operations were carried on with grass growing wild in the jungles. Gradually the wild grass of the two States of Travancore and Cochin was insufficient to supply the increasing demand for the oil from Europe. The distillers of Cochin then began to exploit Malabar where the grass was not known to have any economic value. The owners of the land, on account of the new use of the grass, enjoyed the benefit of seeing it rise to fourteen times its former value. Planters have commenced distillation in the Ernad and Walluvanad taluqs, in the Wynaad, and Venieri in Pudukoti. These hilly regions are covered entirely with lemon grass which is sold at a nominal sum, but the question of specially cultivating the grass for oil in suitable lands is now being considered. It has been said that the new industry will provide an outlet for the energies of the Moplahs whose fanaticism is so well known and, perhaps, may be traced to the straitened circumstances of their existence. In 1903 there were eleven stills at work at Waluvanad, most of them being controlled by Moplahs. The stills used here are more modern in construction than those used in the south, and are made locally at a cost of between Rs. 200 and Rs. 300 each. The copper boiler is six feet high and twelve

feet in circumference. From the head of the still a pipe conducts the steam through a condensing tub filled with cold water and the oil is collected into the vessels used as receivers. An ordinary glass-cutter is paid two annas a headload for the lemon grass, and sixteen of these bundles are sufficient to fill a boiler, which, after distillation, yield one bottle of oil. The best oil before it is bottled is always filtered through paper. When Travancore held the monopoly of the industry, the oil was exported from Cochin, but now that the industry has extended northwards into Malabar, Calicut is becoming a centre of distribution.

Lemon grass oil is exported in reputed quart bottles each of which is guaranteed to contain 23 ounces. One dozen of these bottles make a case. The exports from Cochin have risen from 228 cases in 1884 to 2,387 cases in 1889 and 1,917 cases in 1890. At the present time from 2,000 to 3,000 cases are exported annually from Cochin to Bombay and to various foreign ports, chiefly New York, Hamburg and London.

The following are the exports of essential oils, chiefly lemon grass oil, from Madras during the past ten years:—

	Gallons.	Rs.
1896-97 ..	5,324	79,081
1897-98 ..	6,292	1,33,775
1898-99 ..	4,278	89,745
1899-1900 ..	6,280	1,29,701
1901-02 ..	589	27,376
1902-03 ..	6,258	2,42,319
1903-04 ..	3,889	1,60,505
1904-05 ..	2,721	1,41,489
1905-06 ..	2,675	1,54,141

A large proportion of the oil is absorbed for the manufacture of citral, and ionone—an artificial violet perfume. On this account within the last three years the price has quadrupled. These prices must have proved very favourable to the distillers and traders of the Western Coast, but, on the other hand, fresh sources of supply have appeared which may compete with the present monopoly. An export trade in the oil has recently developed in Java. It is also brought in small quantities from Singapore and Ceylon, and experimental batches have been sent from Tonkin, San Thome in Portuguese West Africa,

Brazil, and Monserrat in the West Indies. Messrs. Schimmel & Co. certify that the Brazilian and West Indian oils are unable to compete with the East Indian oil on account of their insolubility in alcohol. The demand for lemon grass oil is steadily on the increase in England and the Continent, and all things being considered there is a very successful future for its manufacture in India.

Citronella oil, although prepared chiefly in Ceylon, should be referred to in dealing with grass oils. This oil is distilled from *Andropogon Nardus*, a grass cultivated on the slopes of the hills in the Southern Province of Ceylon, and according to statistics as much as 40,000 to 50,000 acres are under cultivation. The first and principal harvesting period is in July and August, and the second lasts from December until February. The average yield is from 16 to 20 bottles oil per acre for the summer and from 5 to 10 bottles for the winter season. The stills, of which there are 600, are modern, and the success of the natives who constitute the majority of the producers is remarkable. There has been an enormous increase in production and consumption of citronella oil in Ceylon, which is shown by the exports reaching in 1899 one and a half million pounds in weight. Since this date exports have declined.

The oil contains citronellal and geraniol; it is occasionally adulterated with fatty oils, petroleum, resin spirit, acetone, and alcohol. It is much cheaper than lemon grass oil, and it is sometimes used for the purpose of adulterating the latter.

Leaving the grass oils which are the chief Indian essential oils that are exported in large quantities, we will consider some of the essences and perfumes which are made and used to a considerable extent in the country. Sandalwood is one of the most important perfumes in the East, as it is one of the most fashionable in the West and is mainly derived from the province of Mysore where the trees are protected by the State. The annual auction sales of the wood from the roots and stems brings in an annual revenue of five or six lakhs of rupees. The wood is sold in grades varying from Rs. 500 per ton for selected logs to Rs. 85 per ton for fixed chips. The wood is purchased by Muhammadans in Bombay, whose agents attend the Mysore auctions, and is shipped to Europe via Tellicherry or Bombay.

The Mysore Government has long had establishments for extracting the oil which is sent to China and Arabia. The oil is procured from the wood by distillation, the roots yielding the largest quantity and finest quality. The yield of the oil is at the rate of 10 ozs. per maund or 25 per cent. and the process lasts several days. The average price of the oil in India is Rs. 8 per pound. Two or three private firms have also established stills, but the oil is said not to compare in properties with that made by European distillers. While it appears desirable from a commercial aspect to prepare the oil in the country that produces the raw material, the indigenous stills are not at present capable of dealing with large quantities. At the factory of Messrs. Schimmel & Co., Leipzig, special appliances are used for comminuting the wood, and their stills are constructed for producing daily four cwts. of oil, with an average yield of 3·3 per cent.

In 1902 it was reported from Mysore that the spike disease has appeared in the sandalwood plantations which was threatening the trees with destruction. The disease had first been observed in Coorg in 1900. There has naturally been an upward movement in the price of the oil in spite of the large quantity of wood sold at the auctions owing to the numbers of trees cut down at Hunsur, Chickmaglur, Seringapatam and Coorg which showed traces of the disease. Unfortunately, no successful remedy has at present been found for the disease; and the future does not look hopeful. A decline in supplies of sandalwood is predicted, as the young trees are particularly subject to the disease, and the growth of new plantations is not at present calculated to keep pace with the consumption.

These remarks on the ancient and favourite perfume of sandalwood oil will appropriately introduce the subject of attars or ottos, of which rose otto is the most important. In former Moghul times, sandal oil was generally used as the basis in preparing all ottos. Col. Phillott, an authority in Persian and Urdu literature, has drawn my attention to an old work published in Lahore, describing the preparation of otto of roses. The copper alembic and condensing appliances are carefully detailed; the former is charged with rose petals and water, but before heat is applied a small quantity of sandal oil is to be placed in the receiver with the object of "drawing over" the

rose essence.' "Each time the otto is prepared sandalwood oil must be placed in the receiving vessel." The resulting essence was no doubt an agreeable perfume, but in modern times it is more satisfactory to obtain the pure essential oils first, and then blend them in known proportions afterwards.

Rosewater is manufactured in Bengal and the Punjab, but a large quantity is imported from Persia. For over two centuries rosewater and otto have been made in Ghazipur on the banks of the Ganges from the damask rose (*Rosa damascena*). The oil distilled there, however, is never pure, being adulterated with other oils. One hundred lbs. of rose leaves or one hundred thousand roses are estimated to produce three drachms or 180 grains of otto and 100 bottles of rosewater. Rosewater to the extent of 20,000 to 30,000 gallons annually is imported into Bombay from the Persian Gulf. Two qualities are met with—Yakatishi (once distilled) and Da-atishi (twice distilled). Its value is Rs. 4 to Rs. 4½ for a carboy of 20 lbs.

Turpentine oil—the essential oil distilled from the turpentine or oleo-resin of the Chil Pine (*Pinus longifolia*)—is prepared by the Forest Department in Northern India. Factories are established at Dehra Dun, Naini Tal, and Nurpur in Kangra. These centres are capable of producing about 20,000 gallons of turpentine oil a year. The whole of this output is consumed in the country, being used in the Medical Stores, Military Department, by several railway companies, and by paint and varnish manufacturers. Samples of the oil have been sent to England, and have been favourably reported upon by such eminent authorities as Professor Armstrong and Sir Boverton Redwood.

Eucalyptus or blue gum oil is now an established industry on the Nilgiri Hills. The blue gum plantations were commenced about sixty years ago, and the wood has been used principally as fuel. About twenty years ago the oil was first distilled from the leaves in the Botanical Gardens, Ootacamund. At the time of the influenza epidemic in 1891, the manufacture was taken up by Mr. Wallace, and the oil was readily bought locally and by the Medical Stores depot in Madras. Lately other stills have been erected at Lovedale and Coonoor and the produce finds an appreciative market.

Camphor is a concrete essential oil largely used in India, and in recent years a great deal has been written regarding the



cultivation of the tree in India and Ceylon. It is well known that the camphor of commerce is largely manufactured in Central China, Formosa and Japan, and is one of those articles subject to monopoly and consequently to advancing values. It has been considered a suitable tree for cultivation in this country, but the prospect of waiting fifty to a hundred years for trees to reach a mature enough condition to yield camphor has deterred many from speculating in the enterprise. It has also been suggested that camphor might be made from the leaves of comparatively young trees, but, as I pointed out ten years ago, there is a small yield of oil in the leaves and the amount of camphor is very variable. Experiments must be made in this direction on a larger scale before definite opinions can be expressed.

Ajwain or ajowan (the seeds of *Carum copticum*) is largely used in medicine, and the oil and water are prepared nearly all over India. The *aik* or distilled water, called *omum* water in South India, is a favourite domestic remedy replacing the well-known dill water of Europe. The oil by spontaneous evaporation at a low temperature yields a crystalline substance or stearoptene known under the name of *Ajowan ke phul*. This substance is identical with thymol, contained in the Western herb *Thymus vulgaris*. Crude thymol manufactured in Central India has an average value of Rs. 8 per lb. There are other plants of the umbelliferous order the fruits of which might be conveniently distilled and the oil exported.

Winter-green oil is largely consumed in America on account of its aromatic and medicinal properties. Its special value resides in the fact that it consists chemically of a compound of salicylic acid, and is a strong antiseptic. One or two drops placed in a bottle of ink or gum used on the office table will prevent the formation of mould. An Indian Winter-green (*Gaulthera fragrantissima*) grows on the Nilgiris and other mountains in Southern India and its essential oil is easily prepared by using an ordinary copper still.

Dipterocarpus oil (Gurjan balsam or wood oil) is obtained from various species of *Dipterocarpus* growing in Assam and Burma. The balsam or oleo resin consists of a resin acid, gurgunic acid, and an essential oil. The oil is becoming more and more important for the trade owing to its industrial and medicinal applications.

I would now enumerate a few indigenous perfumes which are often asked for by English and Continental dealers. These relate specially to delicate scents which of necessity must be made from fresh flowers and plants since the raw articles rapidly deteriorate. The preparation of these oils is thrown out as a suggestion to those who have a small capital and who would be sufficiently enterprising to make experiments.

The essence of Champaca or Champa from the flowers of *Michelia Champaca* is always wanted in perfumery. The small supplies in Europe of this oil are continually being exhausted. The blossoms must be gathered singly just as they expand and must be distilled at once or submitted to the process of enfleurage. No way has yet been devised of otherwise preserving them from rapid decay. Where these trees occur in any abundance a profitable harvest of the aromatic principle could be easily obtained.

Keora essence is another perfume much sought after by European distillers. The flowers have a most delicate scent, but samples of oil placed on the market are usually obtained by steeping the blossoms in sesame oil which destroys all the honey-like characters of the true odour. The keora known by the English name of Screw pine and by botanists as *Pandanus odoratissimus* is a native of India, Persia, and Arabia, and occurs frequently along the Western Coast.

Cassie flowers obtained from *Acacia Farnesiana* yield an excellent perfume for which there is always a demand. The oil consists of a methyl ester of salicylic acid. The tree is wild in most parts of Bengal and the Punjab, and the yellow flower heads perfume the atmosphere very pleasantly. When the plants are cultivated a tree yields 2 lbs. of flowers valued at three to four pence a pound; an acre thus realising £30 to £40.

At Cannes in the South of France cassie pomade is made by the process of infusion. This consists in infusing the substance in a mixture of lard and beef fat in a water-bath. Two pounds of the flowers are immersed entire in one pound of fat; after immersion in the fatty menstruum for the requisite period the mixture is strained off and the residue pressed. The pomade is preserved in large metal vessels. In India the animal fat may be substituted by the petroleum wax or the concrete oil of *Vateria indica*, the Piney tallow of Malabar, or kokam butter—the natural fat of the seeds of *Carcinis indica*.

About fifteen years ago a large consignment of Indian-made cassie pomade was shipped to London and was found to be superior to that grown at Grasse in France. This opinion was confirmed by the eminent firm of Messrs. Schimmel & Co. It is to be regretted that this promising trade was abandoned owing to the death of the gentleman who made this perfume in Naini Tal, but it is hoped that this reference to the excellence of Indian cassie pomade will resuscitate its manufacture.

Patchouli oil is an absolute necessity for perfumery. The true patchouli is prepared from a labiate plant, the *Pogostemon Patchouli*, a native of Malaya and Indo-China. But there are various species of *Pogostemon* in Western India which are marked by their strong perfume and would doubtless yield essential oils if submitted to distillation.

The following list of raw materials for the manufacture of perfumes in India might be added to the more important ones I have been considering :—

- Mesua fenea, flowers. Nagkesur.
- Ochrocarpus longifolius, flowers. Lal-nagkesur.
- Ruta graveolens, herb. Rue, Sudab.
- Zanthoscyllum sp., fruits. Pepper flower.
- Toddalia aculeata, leaves. Milakaranai.
- Munaya Koenigi, leaves. Curry leaf tree.
- Citrus sp. Fruits and leaves. Oranges and lemons.
- Oegle Marmelos, leaves. Bel.
- Feronia elephantum, leaves. Woodapple.
- Hardwickea pimata, oleo-resin. Yenne.
- Prunus armeniaea, seeds. Rubani.
- Prunus insititia, seeds. Alu-bokhara.
- Altegia excelsa, balsam. Nantayok.
- Myrtus communis, leaves and fruit. Myrtle.
- Carum carui, fruits, Sujah-jira, caraway.
- Foeniculum veelgaw, fruits. Fennel.
- Pencedanum graveolens, fruits. Dill.
- Aralia Pseudo-ginseng, root. Indian Ginseng.
- Nardostachys Jatamansi, root. Spikenard.
- Blumea balsamijera, plant. Ngai.
- Sphaeranthus indicus, flowers. Mundi.
- Achillea Millefolium, plant. Biranjasit.

- Spilunthes Acmeila*, flower heads. Pipulka.  
*Artemisia vulgaris*, herb. Wormwood.  
*Sanssurea Lappa*, root. Kut. Paehak.  
*Mimusops Elengi*, flowers. Maulsiri.  
*Nyctanthes arbor-tristis*, flowers. Night Jasmine.  
*Jasminum grandiflorum*, flowers, Jasmine.  
*Plumeria acutifolia*, flowers. Khair-champa.  
*Ipomœa sinuata*, leaves. Noyeau plant.  
*Vitex Negundo*, leaves. Nisinda.  
*Vitex tripolia*, leaves.  
*Ocimum basilieum*, herb. Sweet basil.  
*Ocimum sanctum*, herb. Holy basil.  
*Ocimum gratissimum*, herb. Ram-tulsi.  
*Lavandula stœchas*, herb. Arabian lavender.  
*Mentha sylvestris*, herb. Wild mint.  
*Origanum marjorana*, herb. Marwa, marjoram.  
*Thymus serpyllum*, herb. Wild Thyme, masho.  
*Piper Betle*, leaves. Pan.  
*Cinnamomum* sp., bark and leaves. Indian cinramon.  
*Litsæa polyalthia*, leaves.  
*Aquilaria Agallocha*, wood. Agar, eagle wood.  
*Salix Caprea*, flowers. Bedmishk.  
*Juniperus communis*, fruit. Juniper berries.  
*Cedrus libani*, wood, oleo-resin. Deodar.  
*Kampfelia Galanga*, tubers. Chandra mula.  
*Hedychium spicatum*, tubers. Kapur-Kachri.  
*Alpinia Galanga*, root. Greater galangal.  
*Homalomena aromatica*, root. Gondo matri.  
*Calamus*, Sweet flag.  
*Nigella Saliva*, seeds. Black cummin.  
*Abelmoschus moschiferus*, seeds. Ambrette.  
*Cassias Tetrantteras*, of the laurel tribe.

## THE PADDIES OF BENGAL.

[BEING LESSONS DRAWN FROM THE AGRICULTURAL EXHIBITION OF 1906-07.]

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FOR the purpose of the present Exhibition, most of the Districts of Bengal were ransacked for finding out the most valuable products of the Province. In each place a meeting of actual cultivators was called, and they were catechised in accordance with a printed list that I had drawn up for the purpose. In some cases, as in Murshidabad, Burdwan and Bankura, experienced Kabirajes were consulted. Important information was thus elicited, and the collection which you see in the Agricultural Department shed of this Province is the result of the enquiry. Important economic products, some of which are not even mentioned in Dr. Prain's Bengal Plants, have been found out, in the departments of fodder grasses and other food plants, of drugs, of sugarcanes, of grains, of oils and oil-seeds. You have, for instance, an upland rank growing fodder-grass here (we may call it the *Coix lacinhrimes Jobi*, major), which may make our attempt at the introduction of the Reana grass superfluous. Of course, the aquatic and shorter Job's tear is well known as a fodder plant, but it will not grow on high land, but this one will. Here is a pot-herb (as well as fodder) locally known in the sea-side places of Southern Bengal as *Gere-Ghas* (probably the same as Dr. Prain's *Suæda maritima*), the leaves of which taste so saline that it is cooked without the addition of salt. It would be an excellent fodder to grow on sea-side places where few things will grow. Here is a vine called near Calcutta *Tit-konka*, and the flowers of which are called *Juti phul* (and the flowers are eaten cooked), the fibre of which seems to be stronger than any other fibre, and in some villages it is used for tying fishing hooks to lines. You may have seen sugarcanes 25 feet long and striped sugarcanes called Haragouri which seem to be the origin of the striped Mauritius tanna which is the fattest cane in the Exhibition.

You will find a bundle of canes grown from seedlings and several which grow in water. Here is a grass (Ruisa grass) the fragrance of which would delight the heart of a Raja. The seed of this grass (which is the Motia variety of Ruisa grass) I obtained in the jungles of Baroda and on sowing it in Calcutta I have got one plant which has now seeded and the fragrance is just as good as the fragrance of the original grass. It shows that with patience this can be propagated in Bengal. Here is Dhannantari grass, the botanical name of which is the same as that of the Motia grass, viz, *Andropogon schænanthus*, with which you are quite familiar as the *Agya ghas* or *lemon grass* was declared to be a most efficacious remedy for snake-bite. The roots of this are pounded up with round pepper and given to the patient. But the most remarkable drug is the Harjora pata, which is said to reunite fractured bones. The "yarn" was confirmed by so many cultivators of Bankura that I am rather inclined to believe in it.

2. But the object of this paper is to give you some idea of the paddies collected for this Exhibition. They are nearly all paddies of special value, and the ordinary paddies grown in the country are scarcely represented. Of course, from some districts large collections (which I never wanted) have come, and these contain probably all paddies, common and uncommon. But most of them, you will see, are classified under certain definite groups. These are—

- (1) The drought-resisting paddies.
- (2) The flood-resisting paddies, which class is divided into two groups, (a) those which increase in height with the increase of flood, and (b) those which can remain sunk in water in a live state for a week or more. Those two classes suit two different condition of flooding, i.e., flooding as in Eastern Bengal where the flood remains for some time, and flooding as in the undulating districts where the flood subsides in a few days.
- (3) Paddies which can be grown on hill-sides without terracing.
- (4) Autumn paddies which contain white, fine and fragrant rice.
- (5) Prolific paddies which are also fine and fragrant.
- (6) Paddies with special nourishing value.

- (7) Paddies reputed to have medicinal properties.
- (8) Paddies suitable for making *muri*, *khoi* (pop-corn) and *cheera orcheera*.
- (9) Absorbent paddies, *i.e.*, paddies suitable for making *pelao*.
- (10) Autumn paddies that grow in water.
- (11) Winter paddies that can be grown on sea-side places unprotected by embankment, *i.e.*, in highly saline land.
- (12) Curiosities, such as paddies containing two grains of rice in each, paddies with four to six grains in each spikelet instead of one or two, a paddy of which the whole plant is fragrant, a black paddy the leaves of which also are black, and paddies containing rice which does not require boiling.
- (13) Wild paddies.
- (14) The best paddies of Bengal.

#### (1) THE DROUGHT-RESISTING PADDIES.

3. In considering these we should take into account different levels of land in the same local area, and the districts which are most subject to drought. A paddy that is habitually grown in low-lying lands where in ordinary years water always accumulates, may be a drought-resisting paddy for this class of land and come out scatheless in a year of excessive drought where even the low-lying valleys dry up, but such a paddy would, perhaps, have no chance in such a year if it were grown on a higher level. Again, a paddy that is considered drought-resisting in a moist district like Khulna, would have no chance in a dry year in a district like Sambalpur, Santhal Parganas or Saran. It should be noted also that it is well known among cultivators that the autumn paddies, specially those that are known as Shathi or Sathia (*i.e.*, sixty-day paddy), are recognised by cultivators as drought-resisting. The chali rice of Bankura, in fact, is said to ripen in 40 days. These are not much grown because, as a rule, the yield of autumn paddies is less than that of winter paddies, and the grain is red, coarse and indigestible. We must, therefore, take special notice of paddies that have been recognised to be drought-resisting in dry districts, in high soils, and paddies which are prolific in yield and which produce white, fine and fragrant rice.

4. Karibank, one of the best paddies (*i.e.*, fine and fragrant) of the Patna Division is a drought-resisting winter paddy. The Khera paddy of Darbhanga and Saran, which, though a coarse winter paddy, produces white rice, and this is also drought-resisting. Of early or autumn paddies of the Division may be mentioned Silangti and Katika.

5. In the Orissa Division the Gopalbhog paddy of Cuttack and Puri, which is a fine, white, and scented winter paddy, stands drought fairly well. But the Sahara paddy, also of Cuttack, though a coarse winter paddy, should be brought prominently into notice. It will live for about a month after other paddy crops have died of drought. The leaves of the Sahara paddy wither and die first and then the ears. In the shrivelled-up condition the grains of Sahara taste bitterish, but these are quite useful for seed, retaining even in the shrivelled-up condition their germinating power.

6. Of autumn paddies the Kala-satia of Balasore is the most drought-resisting of all the varieties of Biali or autumn paddy.

7. In the district of Sambalpur, for the *at* or highest lands, Kalia and Saria, which are both coarse autumn paddies, are considered the most drought-resisting. For the next highest lands which are known as *mal* Kala-hansu, Karanja, Karni and Banku, are recognised as the most drought-resisting and they are all *laghur*, *i.e.*, early winter paddies. With the exception of the last-mentioned paddy, all the others are black coloured. For the next highest lands, called *berna* lands, Phuler, Kakuri-manji and Kankria paddies are the most drought-resisting. These are all *aman* or *laghu* paddies. The lowest class of soil in Sambalpur is called the *bahal*. For these, Kiaketki, Thakur-bhog, Hanslo, and Sal-jhanti are the most drought-resisting of all these varieties of paddy, the Salijhanti being the finest and best.

8. In the Burdwan Division, the Manik-kalma, Harkol and Kaya, which are coarse winter paddies and Aus-Ramsal, which is a fine autumn paddy, are the most drought-resisting. They are all Bankura paddies, *i.e.*, paddies which are naturally subject to drought. In Midnapore, the Kaya-dhan, a coarse upland winter paddy, is the most drought-resisting. We may dismiss from consideration the paddies of Howrah, Murshida-



bad, Khulna and other low-lying districts where the paddy crop is never subject to such conditions of drought as it is in the districts mentioned. In any part of India, where the crop is subject to excessive drought, seed of the one or the other variety of paddies mentioned may be tried experimentally.

Before leaving this subject I must mention a very successful experiment which I initiated at Sibpur in 1898. I brought a handful of a fine *aus* paddy from Bilaspur that year, and sowed it at Sibpur and I got very good result from it. The theory with which I started was—a paddy (which was also a fine and white paddy) which was naturally subjected to severe conditions of drought in a district where the rainfall was very much lower than that in any part of Bengal, was likely to do better in the climate of Bengal where such severe conditions seldom prevailed. Then I found that this paddy, after harvest, sent forth new leaves and a few ear-heads. Though as a crop this aftermath was not worth gathering, I protected and gathered the few grains for seed to be used the next year. The seed produced a more luxuriant and a more drought-resisting crop, and the crop took a month more ripening than the original crop. The result has been confirmed year after year at the Sibpur Farm, and the distribution of the 2nd cutting seed among cultivators of such widely divergent districts as Maldah, Chittagong, Hazaribagh and Cuttack, has given remarkably good result. You will find this paddy described as “Mukerji's paddy” in the Sonthal Parganas collection. A nomenclature is a good plan for distinguishing a paddy though the present one is rather euphemistic. Even in some of our experimental farms they cannot say whether the C. P. Fine *Aus* they are growing is originally from the first or second-cutting seed. Both varieties are called “C. P. Fine *aus*” though the one differs from the other so much in essential qualities. The C. P. Fine *Aus* originating from the second cutting seed, is a deeper-rooted, later, more drought-resisting and more luxuriant variety of paddy, and it should have a distinct name to avoid confusion.

10. Then I would like to tell you of another experiment of mine on similar lines, which has resulted in the introduction into Bengal of a long, sweet-scented, and absorbent paddy from the frontier districts of India. This is the Swati paddy which is now grown not only at the Sibpur Farm, but in Cuttack,

Hazaribagh, and in other districts differing from each other in climate, as you can infer from the collection of this paddy in the Exhibition. I do not pretend to say that the Swati paddy will make more fragrant and better *pelao* than the Cabuli paddy which has been kindly sent to the Exhibition by H. H. the Maharaja of Gidhour. But the prolificness of the Swati originally obtained from the "second cutting seed" cannot be beaten by any Peshwari paddy from the first cutting seed. *Swati* from the 2nd cutting seed, indeed, produces as large a crop as the 2nd cutting C.P. *Fine aus*, and almost as much as the coarse varieties of winter paddy. This is due to the crop from the 2nd cutting seeding in September instead of in August. The fertilisation of these paddies, which have very open panicles, is prevented by the heavy rains of August which wash out the pollen grains, and though the plant from the large seed is always vigorous, the ears when ripe contain a very large proportion of empty grains. This is prevented by obtaining a crop which takes a month longer coming to ear. While a Peshwari paddy from the "first cutting seed" whether Cabuli, Swati, Bara or Madhurnate, yields only 7 to 10 maunds, the yield from the Swati originating in the "second cutting seed" has been yielding 18 to 21 maunds per acre. The large-seeded, vigorous growing and drought-resisting Peshwari paddy is thus worth while for even the cultivator to grow and to use.

11. Both the C. P. *Aus* and the Swati are drought-resisting paddies and particularly suited to the dry regions of India. For detailed report of these experiments you are referred to the Reports of the Sibpur Experimental Farm since 1900.

#### (2) FLOOD-RESISTING PADDIES.

12. While seeking for the drought-resisting paddies in regions of the country which are naturally subject to drought, we should seek for flood-resisting ones in localities naturally subject to accumulations of water. There are two ways in which water accumulates. In undulating tracts floods come and after remaining for a few hours or a few days they subside; while in flat countries, like the districts of Eastern Bengal, the flood comes in more slowly and remains longer. For the former tracts we must seek for paddies that can stand submergence under water

for some days, say up to a fortnight or twenty days, and for the latter we require long-stemmed paddies. These two classes of paddies are arranged separately in the Exhibition.

(a) *Paddies that stand submergence under water.*—Dahar-nagra of Nadia and Burdwan and Meghi of Nadia and the 24 Parganas, are coarse winter paddies which are recognised to be flood-resisting paddy plants of Lower Bengal. But in Cuttack there is a drought-resisting, sweet-scented, fine and white winter paddy which can also stand submergence under water up to 15 days, except at the *thhor-mukh* stage, i.e., when the plant is coming into ear when it cannot stand submergence for more than 4 or 5 days. It should be also noted, that paddies can stand longer submergence in clearer than in more turbid water, e.g., in *bib* water or the water of the Jamna, (than in the water from the Ganges or the Rupnarayan). Gopalchog, a variety of Cuttack paddy, is eminently suited for introduction in those undulating tracts where loss from floods take place occasionally. At Puri there is a coarse *Laghu*, i.e., early winter paddy, called Patia-dhan, which can stand submergence under water for 15 to 30 days. In Sambalpur, where the land is as undulating as in the Chota Nagpur division, there are two distinct classes of flood-resisting paddies for the two classes of winter paddy land, for *Berna* lands which are not so low as *Bahal* lands. Kankria and Kharkuiti varieties of early winter paddy stand flooding best, and for *Bahal* lands, which are better suited for long-stemmed paddies, Jalghanta paddy will stand submergence for a week. In Bhagalpur and Monghyr, long-stemmed paddies are more suited for *bil* lands, but there is a variety of winter paddy called *Jaria* which would live submerged under water up to 15 days.

(b) *Long-stemmed Paddies.*—Where the rise of water is gradual and where the water stays for months, the long-stemmed paddies and some Boro paddies are recognised as the best. The most important variety of long-stemmed paddy is the Kershai, which is grown in the districts of Nadia, Jessore, Khulna and 24 Parganas. Bankui grown in Midnapur and Jessore is another of these long-stemmed paddies, and Rabana grown in Puri and Balasore is also a well-recognised variety. Other long-stemmed paddies are Kocho of Howrah, Muktahar, Lal-kanai, Neto, and Phul-amla of Nadia, Dalkachu, Kalaboyra and Rajaman-

dal of Jessore ; Kainata and Usna-champa of Puri ; Sankara of Balasore ; Rajganji and Pushangla of Sambalpur ; Panidubki of Singhbhum ; Jessaria-dhan of Hutwa, Saran ; Panjhali of Bhagalpur and Sathi Boro of Monghyr. There are two long-stemmed winter paddies which are fairly fine, viz., Hardiphul of Dumraon, Arrah, which is also a highly prolific variety of paddy, and Aman paddy of Puri. It should be noted that there is a coarse and a fine variety of Hardipul in Dumraon, both long-stemmed and both prolific.

(3) *Paddies that can be grown on hill-sides without terracing.*

13. The value of this class of paddy was first brought to my notice by Mr. Maude, Commissioner of the Chittagong Division. In that Division of Eastern Bengal the rainfall is very heavy, but the hill-sides are not much cultivated. I found there was a local variety of very superior and fine autumn paddy, called Chandramuni, that is grown in certain localities on hill-sides without terracing. The C. P. Fine *Aus* which our Department had introduced into Chittagong was also found to do well on hill-sides. Since then I have noticed the following varieties of paddy belonging to our own Province suited for this purpose—

(1) Anandi, a Champaran paddy which is chiefly used for making muri,

(2) The Satika-dhan of Puri and other neighbouring districts,

(3) Gora-dhan of Manbhum and Hazaribagh,

(4) Chali-dhan of Bankura,

(5) Kansa gora of Singhbhum,

and (6) Harilimbo and Minyo paddies of Ranchi.

It should be noted that the two last-mentioned varieties, are very fine, and Harilimbo is fragrant besides.

(4) *Fine, white and fragrant Autumn paddies.*

14. The ordinary autumn paddies of Bengal are coarse, red and indigestible paddies which are in disfavour with all. They are grown like millets on high lands, because they are drought-resisting, and because they take only about three months maturing. The varieties known as *Shati* or *Shatika* (*id.* 60-day paddy) take still shorter to mature. The autumn paddy is, however, a most valuable staple, as after harvesting

this crop the land can be prepared for a second crop. The autumn paddy does fairly well in a year of short rainfall, and although it is, as a rule, not as prolific as the winter paddy, it does not run such risk of utter destruction from drought. One of the principal experiments of our department has been in connection with the introduction of the C. P. Fine *Aus* already referred to. But there are better staples still in Bengal as you can see from an observation of the specimens in the Exhibition. There is the Harilimbo, already mentioned as a hill-side paddy of the Ranchi District. There are the Rajbhog, Modo and Surjomani paddies of Nadia, Modo and Rajbhog, being as prolific as a winter paddy. I may also mention the Benaphul of Jessore; the *Aus-nona* of Murshidabad; the Kartika Gayabali of Midnapur; the *Aus-Ramsal* of Bankura; the Durgabhog-gora and Ramsal-gora of Singhbhum and Manbhum; the Maturia, the Kartika and Saj-behanwa of Dumraon (Arrah), as the other high-class autumn paddies of Bengal, which should be introduced as drought-resisting staples in all precarious tracts.

(5) *Prolific winter paddies which are also fine and fragrant.*

15. To this class of paddy my attention was first directed by the large yield I got at the Sibpur Farm from the Badsabhog variety of paddy. This paddy has been since tried in Hazaribagh and other districts with similar result, and its introduction can generally be recommended both in damp and in dry regions, in lands which are considered specially suited for winter paddies.

16. Other prolific, fine, and fragrant winter paddies are Gondaha and Chalta-phita of Patra; Benibhog of Cuttack; Khasagundi of Puri; Dudshar of Balasore; Rudru of Ranchi; Kalajora of Singhum and Bansmati of Burdwan. In this connection I may mention a very hardy Sambalpur paddy, Kiaketki, which is not only fine and prolific, but which is both flood-resisting and drought-resisting.

(6) *Paddies with special nourishing value.*

17. I had hoped to have got the paddies of Bengal which have been collected under this head chemically analysed, so as to ascertain whether the paddies reputed to be specially nourishing and strengthening, actually contain a higher proportion of proteids and fats. But time has been too limited for such a purpose. I hope, however, the analysis of

these paddies will be taken up, and it may be judged how these paddies compare with wheat, oats, barley and other strengthening food-grains. The ordinary rices eaten by the upper classes are considered weakening by cultivators, but there are only a few paddies that have the reputation of being particularly strengthening. These are: (1) *Jaunga* of Hazaribagh and Bhagalpore which is a black and awned paddy, which is not very coarse and very sweet in taste; (2) the *Sathi* Boro paddy of Monghyr is also strengthening; (3) the *Nagara* dhan of Ranchi; (4) the *Kaya*; (5) *Meghi*, and (6) *Rashu* of Manbhum; (7) *Kalai chusi*, and (8) *Manuga-Kalma* of Bankura; (9) *Khukni* and (10) *Lakshumi-kajal* of Jessore; (11) *Jabradhan* of Khulna; and (12) *Boyarbant*, (13) *Dholabokra* and *Roya-biri* of the 24 Parganas.

(7) *Paddies reputed to have medicinal properties.*

18. I have consulted both Kavirajes and cultivators in making this collection. Several districts have each one or two paddies which have wide repute for some medical property. Of these *Paramayushal* or *Paramannashal* enjoys an inter-district reputation as being a very valuable paddy to use for long-standing dyspepsia. *Kabasar* paddy of Dumraon and *Thina* paddy of Hutwa yield rices that are eaten when a patient is recovering from diarrhoea; and *Gumrhi* rice of Darbhanga is eaten by patients actually suffering from diarrhoea. *Madhukar* rice of Behlia (Hutwa) is said to be efficacious for nervous diseases. *Rargdumala* and *Nandi-maccha-kanta* are two Cuttack paddies which produce *Khai* which is eaten by people suffering from eczema (*Khujli*). The cake made out of *Karni* rice meal is used by patients suffering from dropsy in Sambalpur. It is also given in cases of diarrhoea in domestic animals; and the cake is also used with medicine when children suffer from asthma or general debility. *Teni* or *Jhara* dhan rice, which is rice from a wild paddy, is also used for dropsy. *Karpursal* for convalescents and for nervous exhaustion, and *Karhani* rice for gonorrhoea. The ashes of this last-mentioned rice are also used for bad eye-sight in Ranchi and Hazaribagh. In Manbhum gruel of old *Paramayushal* rice is given to cholera patients. In Bhagalpur *Raksadhan* is used by patients suffering from gonorrhoea, and *Hora-dhan* by convalescents after severe illness. In Monghyr,

Sylheti rice is used by convalescents. In Burdwan Pakshiraj paddy is regarded as a medicine for apoplexy, and Ramsal for fever and diarrhoea. Shati-dhan rice is also used in Burdwan for curing nervous debility and in Bankura by convalescents. In Midnapur, Kalindi-dhan and Anandsal k̄hoi (popcorn) is used by patients suffering from diarrhoea, and Parbati-kaya dhan is pounded and applied as poultice over the chest for pains. In Murshidabad, Shani-dhan rice is eaten by women suffering from female disorders. In Khulna the gruel of *Uri* (wild) rice is eaten by convalescents, and in the Satkhria Sub-division of Khulna, Keleparangi rice is fried and powdered, mixed with kele-jira, and applied as a blister for pains and swellings.

(8) *Paddies suitable for making k̄hoi, mure and chura.*

19. There is a large collection of these paddies, every district having 3 or 4 paddies specially set apart for these purposes, Kanakchur being the most noted paddy for k̄hoi. It grows best in soils where water can be kept continually, and so it does not grow in every district. For *k̄hoi* and *muri* the test is the number of times the grain swells up from the original measure, the ideal being ten measures in the case of *k̄hoi*. For *chura* the finest paddies are chosen by the rich and the largest by the poor. There are also certain special paddies that make the largest and softest *muri*. The best *muri*, *chura* and *k̄hoi* are made in the districts round about Calcutta and the enumeration of the paddies grown for these objects in the Burdwan and Presidency Division will be enough for our purpose. These are for *Burdwan Division*.

- |      |  |     |                                 |   |          |
|------|--|-----|---------------------------------|---|----------|
| (1)  | Kanakchur, which is good<br>both for <i>muri</i> and <i>k̄hoi</i> .  | }   | Burdwan and other<br>districts. |   |          |
| (2)  | Ramsal dhan for <i>muri</i> .  |     |                                 |   |          |
| (3)  | Dud-kalma, a prolific variety of winter paddy, which<br>is largely used in the Howrah District for making<br>coarse <i>chura</i> . |     |                                 |   |          |
| (4)  | Jhingasal  | for | <i>muri</i>                     | } | Bankura. |
| (5)  | Jhagru   | "   | "                               |   |          |
| (6)  | Daijira  | "   | "                               |   |          |
| (7)  | Chhanchimol  | "   | <i>k̄hoi</i>                    |   |          |
| (8)  | Kalamkati  | "   | <i>chura</i>                    |   |          |
| (9)  | Kaminidhan   | "   | "                               |   |          |
| (10) | Danatgunri   | "   | "                               |   |          |

(11)	Jamai laru	"	<i>khoi</i>	}	Midnapur.
(12)	Bhunri-panloy	"	<i>muri</i>		
(13)	Panloy	"	<i>chura</i>		
(14)	Badsabhog	"	<i>high class chura</i>		
(15)	Kalma	"	<i>muri</i>	}	Murshidabad.
(16)	Latai chawl	"	"		
(17)	Nona paddy	"	<i>chura</i>		
(18)	Dud-kalma	"	<i>muri</i>	}	Nadia.
(19)	Mol	"	"		
(20)	Nona	"	"		
(21)	Kele	"	<i>khoi</i>		
(22)	Bankchur	"	<i>chura</i>	}	Nadia.
(23)	Korimsal	"	<i>chura</i>		
(24)	Sundarsal is excellent for <i>khoi</i>				
(25)	Malbhog for <i>khoi</i> , <i>chura</i> & <i>muri</i>				
(26)	Machranga	"	"	}	Jessore.
(27)	Kathmal	"	"		
(28)	Biringi	"	"		
(29)	Bhatial megli	"	"		
(30)	Derekhacchi for <i>muri</i> in Khulna.				
(31)	Marich-shal for <i>khoi</i> .				
(32)	Lakshikayal for <i>khoi</i> .				
(33)	Hamai for <i>muri</i>				
(34)	Bangeshwar " "				
(35)	Dholabakra " "				

20. It is not meant that in the other Divisions there are not as good paddies for *khoi*, *muri*, or *chura*. Indeed, there is hardly one of those mentioned equal to Kankjir of Dumraon for *khoi* or to Karibank for *muri* and to Karpursal for *chura*. These two are both Patna varieties of paddy. The Kalajira of Cuttack is as good as any for *chura*.

(9) *Absorbent paddies suitable for making pelao.*

21. Of these the *Cabuli* paddy of Gidhour should, perhaps, be given the first place. But the *Sicati* variety introduced by the Agricultural Department is also highly appreciated for its delicate flavour and its high yield. There are, however, some indigenous paddies which are spongy and able to absorb a large proportion of *ghi* and which enjoy local reputation for making *pelao*. These are Makar-kalam of Ranchi, Sital-chini of Hazari-



bagh, Sorshe-phul and Badasabbhog of Manbhum, Kakri dhan of Singhbhum, Badsapasand and Sitaesal of Bhagalpur, Bansmati of Monghyr, and Gayabali of Midnapur.

(10) *Autumn paddies that grow in water.*

22. I have been able to collect two of these paddies that are particularly suited for places where there are practically no high and dry lands. These are Dalkachu of Jessore and Nantali of the Satkhira sub-division of Khulna. The latter can grow in water 3 to 5 ft. deep. Paddies that grow in water and in lowest classes of land, are usually the latest to ripen. It is important, therefore, to have in view for particular localities these two paddies which take only about three months ripening.

(11) *Winter paddies that can be grown in highly saline lands, i.e., in sea-side lands unprotected by gramhheris or embankments.*

23. Four of these paddies have been collected from the Satkhira sub-division of Khulna, viz., (1) Derekbacchi, (2) Dhalshar, (3) Hamai and (4) Hanuman-jata. The importance of this variety of paddy for the Sunderbans and for similarly situated tracts is self-evident.

(12) *Curiosities.*

24. There are a few paddies which contain in some two grains of rice in each shell. The two grains are so intimately joined together that they look like one grain of rice at first sight. But in rubbing between the palm and the thumb the two grains separate out, as they do in the process of husking. The Nariacha-ungra paddy of Cuttack and the Ekti-dhane-duti-chal of Bankura are the two rices that have been gathered possessing this quality, which, however, is of no practical value.

Khajur-thupi of Bankura and Khajur-chhari of Burdwan, the 24 Parganas and other districts, are paddies with a peculiar inflorescence, there being 5 or 6 grains in a panicle instead of one or two. Paddies with such inflorescence are more prolific, and this character has, therefore, some importance. In Bankura there is a paddy called Nuchi which is sometimes grown twice during the same year. When flooding spoils this paddy it is afterwards grown as a Boro-paddy, being sown in December or January and harvested in March or April. The Dainunipur of Sambalpur is entirely fragrant, not the grains only, but the whole 'plant.' The Payra-pankhi or

Pakshiraj has peculiar wing-like processes on the two sides of each grain. The Dedhia rice of Ranchi, like the Boka-chal of Assam, does not require boiling but only steeping in hot water, to be edible. *Katang-jhali* and other awned paddies are useful in that they are not subject to attack of birds and wild boars. Of all curious paddies, perhaps, the Quilli-rai of Sambalpur is the most important. This paddy has not only its grains but leaves also black, and it can, therefore, be distinguished readily from other paddies at all stages of growth. As the plants of wild paddy cannot be distinguished from other green-leaved paddies until they flower, where lands get overrun with wild paddies, weeding is facilitated if Quilli-rai is sown. Quilli-rai, being a fine variety of winter paddy, this is a great advantage.

(13) *The wild paddies.*

25. From the exhibition collection it will be noticed that wild paddy grows in almost every district of Bengal. As the grains shed very readily, wild paddies are regarded as a weed and at best as a fodder crop. But in some districts they are carefully gathered and used for medicinal purposes or making puddings (payash); the fine varieties of wild paddy are very good eating. There are fine and coarse, white, red and black, and early and late varieties of wild paddy. They are known variously as *Uri*, *Phara*, *Hora Phagri Pasari*, *Balienga*, *Fharanga*, and *Teni*. In Balasore the Balunga rice cake is largely used and it swells better than cake from other cereals.

(14) *The best paddies of Bengal.*

26. This is an extremely difficult question, if, out of hundreds of fine and fragrant rices any one has to be declared as the best of all. After all, it is not the albuminoid ratio, or the yield that will determine the value of a rice, but its fineness, whiteness, look, fragrance, and toothsomeuess. There are hundreds of paddies sent in which rival each other in these respects, though I had tried to restrict the zeal of collectors in this respect, by asking them to send only the very best. There is difference of opinion in every district as to which is the best paddy and, as a rule, several have been sent in as the best. The following I believe to be the best. Basumati and Lajukbadan of Cuttack; Prasadbhog of Hazarbag and Ranchi; Dana-gunri of Manbhum; Ambica-Sur Malbhog, Jogannathbhog, Titasol, Budsabhog, Badsapesand, Samudrabali and Karibank of the

Bhagalpur Division, Khaskhani, Bansmati, Bhashamanik, Gopalbhog, Tulsimukul and Kalajira, of the Burdwan Division; Khirkan of Khulna; Golapsaru, Haludguri, Labangalata, Lila-bati, Bans-Kanta, Dudhsar; Madhumalati, Manlata, Chamarmuni and Chandrakona of the 24 Parganas. If one winter paddy has to be named above as the best in Bengal for yield, for hardness, for fineness, and for fragrance, we must mention the Badsabhog; and if one autumn paddy has to be named which for hardness, yield, for firmness, and fragrance excel every other, perhaps the Rajbhog of Nadia must be given the preference. With regard to Bansmati, I may mention that the paddy tillers well and the use of 10lbs. of seed per acre is found to be sufficient.

27. *Conclusion.* You will find two bottles of paddy from Sambalpur, illustrating the effect of selection which is systematically practised by the best cultivators of that district. The earliest ripening and the largest heads of paddy are first picked from a field and they are separately reserved for seed. What large heads are obtained by cultivators in whose families this custom is followed can be seen from those two bottles. I could also draw your attention to two bunches of paddy plants sent in by Babu Troilokya Nath Chatterji, Khulna (from whom we have got some of the most remarkable exhibits). The larger bunch is from one seedling and the smaller bunch from several seedlings, planted at one spot. The experiment has been conducted at Burdwan and Sibpur also with similar results; and, in concluding this paper, I would urge upon you to impress upon cultivators the fact that they simply waste seed by putting in half a dozen or a dozen plants at each spot instead of one, while transplanting paddy. Considering that the cultivator has sometimes to do sowing of paddy twice over, when the season is unfavourable, they ought to be very careful in economising seed. The result will be larger produce, not a smaller produce. It is often said, the Agricultural Department is able to advise nothing that meets the poor condition of the ryots, that all experiments and exhortations with regard to saltpetre, improved ploughs, and centrifugal pumps and oil-engines, are so much energy thrown away. I hope, gentlemen, I have advocated nothing in this thesis which the poorest ryot cannot benefit by, without spending an anna more than what he is accustomed to.

# THE BEST INDIAN WOODS FOR THE MANUFACTURE OF MATCHES AND MATCH-BOXES.

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IN Sweden, the most noted match-manufacturing country of the world, Aspen (*Populus tremula*, Linn) is the wood found best suited for matches and match-boxes, and pines occupy the second rank as regards the former. The nearest approach to it in botanical relationship is made by a tree which is found in Kashmir and the Punjab Himalaya as also in countries west of that region, such as Afghanistan and Baluchistan. But it is nowhere in great abundance and a great obstacle to increasing its stock is that it very seldom produces any flower or fruit. It can, therefore, reproduce itself naturally, chiefly by the shoots which spring from the roots or artificially by means of cuttings. The botanical name of this tree is *Populus alba* and the Kashmiris call it *Jangli Frast*. The wood of this tree is not wholly unknown even in distant Bengal, for it is in small round boxes made of this wood that we see grapes sold in the cold weather by the men known to us as Kabulis.

Although this wood is eminently well suited to the purpose, its small supply will preclude its use anywhere outside the northern districts of the Punjab.

'Pines' is a term applied loosely in commercial parlance to a number of trees which, although coming under the same Natural Order, Coniferæ, belong to very different Genera or groups of it. None of the European pines, however, grow naturally in India; we have, therefore, to find their substitutes in the coniferous trees that are indigenous in our forests.

Before proceeding to select the most suitable woods, it seems necessary to investigate briefly what characteristics should be sought for in such woods.

Both for the purpose of matches and match-boxes, it is necessary that the wood should be easy to split and at the same

time elastic and strong enough not to break in splitting or in bending to make the boxes; and for matches it is also necessary that it should take fire easily and should continue to burn steadily with a flame when ignited and that it should not emit an unpleasant smell in burning. It is also an essential point that the supply should be sufficient locally or be easily available in quantities where match factories are likely to be established.

To begin with the first characteristic, that of splitting with ease. This depends mainly on the structure of the wood. Avoiding anatomical and technical details, wood may be said to consist of fibres which run parallel to the axis of growth and which, in dicoty ledons, (i.e., in plants other than of the nature of palms, bamboos or ferns), are held together by thin fibrous plates which lie in vertical planes radiating from the centre of the tree. Ease in splitting depends on the length and straightness of the vertical fibres and on the fineness, regularity and abundance of the vertical plates which are called *medullary plates*. These plates are best seen on a transverse section where they show as radiating lines, like rays from a luminous point, either continuous or broken, and are usually and more aptly called *medullary rays*. Knotty wood is more difficult to split than wood free from knots, for around knots the fibres get twisted and are more closely packed, and there is generally much want of uniformity of structure in their neighbourhood. Some trees naturally grow straight and more or less free from knots, and it is preferably from among these that we have to make our selection. When trees are grown scientifically in forests or plantations, they can be forced to grow straight and comparatively free from knots even though they would not do so in nature.

For the particular purpose of matches the wood should also be soft and light. A soft and light wood, provided the fibres are straight and elastic and the medullary rays fine, regular and numerous, splits with a smoother and cleaner surface than a heavy and hard wood. A little amount of strength and elasticity must be combined with softness, otherwise it would be impossible to obtain splinters of any required length, and the match-sticks would break in rubbing to ignite them. It is owing to want of strength that the refuse sticks of the jute plant known in Bengal as Pát-káti or Pan-kati though very soft and light are

unsuitable for lucifer matches, although they were excellent for the old-fashioned sulphur matches of two generations ago, for which they were very extensively used.

In modern factories in Sweden the wood is first turned on lathes against a broad blade which peels off from it a long sheet of wood of the thickness of a match. This sheet is then cut up and split by machinery into separate sticks of the size of matches. But whatever be the process, the quality of wood sought for will remain much the same.

The second desideratum, that of taking fire easily, is also considerably affected by the softness and lightness of wood, for a soft and light wood takes fire more easily and, if perfectly dry, also burns steadily when ignited. A straight-grained, soft and light wood has the additional advantage of drying quickly and thus becoming fit to burn well soon.

In the higher grades of lucifer matches the combustibility of the sticks is artificially augmented by impregnating them with a hydrocarbon like paraffin. Some woods, like the pines, are naturally resinous or oily. They can, therefore, to a certain extent dispense with the hydrocarbon bath. Matches of inferior quality are tipped with sulphur to make them burn well.

The third property, that of not giving an unpleasant smell in burning, in respect of our Indian woods, has not yet been sufficiently investigated. But it will be seen that it is of comparatively small importance except for the very highest grades of matches; for although sulphur-tipped friction matches give a strong pungent smell, they hold their own in the market owing to their cheapness.

The question of supply is obviously of very great importance and is really a question of the geographical distribution of the species selected. I have already mentioned *Populus alba* which would be very suitable for the purpose, but which cannot be depended upon, as we cannot get enough of it from our forests and, as has already been said, there are serious obstacles to artificially increasing its stock.

In the description which I now produced to give of the woods that seem to be suitable for matches and match-boxes, the above points have been kept in view as far as possible. I think it but proper to add that with the exception perhaps of the Conifers and the Poplars, I possess no certain knowledge as to the actual

suitability of any of the other woods mentioned. All that I have been able to do, during the short time allowed me for the paper, has been to go through the Wood Museum of the Imperial Forest College, Dehra Dun, which is admitted to be one of the finest in the world, and to closely examine those specimens which appeared to me most suitable. For the weights quoted as also for many other items of information, I am indebted to the classic work of Mr. J. S. Gamble, M.A., F.L.S., F.R.S., C.I.E. (*Manual of Indian Timbers*).

1.—*Magnolia Griffithii*, Hook F. Vernacular *Bor. Gahori Sopa* (Assam). Wood soft, greyish white, weight 28 lbs. per cubic foot. Medullary rays fine, numerous, short. Habitat—moister parts of Assam, including Cachar. Apparently not very abundant.

2.—*Bombax malabaricum*, DC. Vern. *Simul* (Bengal). The well-known Silk Cotton Tree. Wood very soft, greenish brown, containing a large percentage of phosphoric acid. Weight 17 to 32 lbs. per cub. ft. Medullary rays numerous. Habitat—throughout the plains of India, also Burma and Ceylon, generally affecting damp localities. Easy to grow both from seed and cuttings and very fast-growing.

3.—*Ailanthus excelsa*, Roxb. Vern. *Maha-nim* (Uriya). *Ghor-karm* (Palamow). Wood white, soft. Weight 23 to 28 lbs. per cub. ft. Medullary rays numerous and close. Habitat—Chota-Nagpur, Northern Circars and the Coromandel Coast. Not very abundant but can be easily grown from seed and cuttings, and is a remarkable fast-grower.

4.—*Boswellia serrata*, Roxb. Vern. *Salai* (Bengal). Wood white, moderately hard. Weight 28 to 40 lbs. per cub. ft. Medullary rays, rather broad, very short, not very numerous. From point of structure this wood is not very suitable, but it contains a gum-resin owing to which it gives an agreeable smell when burnt, and matches made of it are likely to burn steadily and well. Habitat—dry hills from Rajputana to Chota-Nagpur, Orissa and Northern Circars: usually quite abundant where it grows.

5.—*Gomphandra axillaris*, Wall. Wood greyish white, soft. Weight 31 lbs. per cub. ft. Medullary rays broad. A small tree of Sylhet and the Malabar Coast.

6.—*Holigarna Beddomei*, Hook. F. Wood greyish white and soft. Weight 26 lbs. per cub. ft. Medullary rays fine and short, not very numerous. A large tree of the Western Ghats.

7.—*Spondias mangifera*, Pers. Vern. *Amra* (Bengal). Wood greyish white and soft. Weight 20 to 30 lbs. Medullary rays—some fine and other broader, fairly numerous. Habitat—Sub-Himalayan forests, Assam, Eastern Bengal, Burma and the Deccan. Grows very fast and can be very easily propagated by cuttings.

8.—*Sesbania grandiflora*, Pers. Vern. *Bak* or *Bak-phul* (Bengal). Wood soft and white, weighing about 30 lbs. per cub. ft. Medullary rays fine, numerous. It is not an indigenous forest tree, but can be easily grown in Bengal and most other parts of India.

9.—*Erythrina suberosa*, Roxb. Vern. *Dholdhak* (Hind.) Wood very soft, whitish. Weight 17 to 20 lbs. per c. ft. Medullary rays short and broad. Habitat—dry forests of India and Burma.

Other species of *Erythrina*, of which *E. indica*, Lam. is well known in Bengal as *Palitamadar*, occur in E. Bengal and Burma and have wood very similar to the above.

10.—*Pithecolobium lobatum*, Benth. Vern. *Tanyin* (Burma). Wood grey, moderately hard. Weight 30 to 35 lbs. per c. ft. Medullary rays very fine and numerous. Habitat—tropical forests of Burma.

11.—*Gyrocarpus Jacquini*, Roxb. Vern. *Pitella* (Uriya). Wood grey, soft. Weight about 22 lbs. per c. ft. Medullary rays very short and moderately broad. Habitat—Orissa to N. Circars and the Deccan, also the Cocos Islands.

12.—*Tetrameles nudiflora*, R. Br. Vern. *Sandugaja*, (Bengal). Wood white, soft. Weight per c. ft. about 24 lbs. Medullary rays fine but clearly marked. Habitat—Darjeeling Terai and the Garo Hills; also Burma and the Western Coast. Much used for tea-boxes.

13.—*Anthocephalus Cadamba*, Mig. Vern. *Kadam* (Bengal). Wood whitish, somewhat hard, weighing about 40 lbs. per cub. ft., often of an unpleasant smell. Medullary rays fine and numerous. Very common in E. Bengal and Assam and in the Darjeeling Terai. Also found in the forests of Pegu in Burma. Growth very fast.

14.—*Hymenodictyon Obovatum*, Wall. Vern. *Sirid* (Marhatti). Wood brownish grey, soft and smooth-grained, weighing



about 28 lbs. per c. ft. Medullary rays some fine and close, others broad and distant. A large tree of the W. Ghats.

Very similar but having a somewhat harder wood is *Hymenodictyon excelsum*, Wall. Vern. *Bhalena* or *Bhaultan* (Hind.), which is found in dry forests throughout India.

15.—*Cordia Myxa*, Linn. Vern. *Bahal* (Bengal); *Lassora*, (Hind.). Wood greyish, somewhat hard. Weight very variable, the average being about 33 lbs. per c. ft. Medullary rays short, moderately broad and fairly numerous. Habitat—India and Burma, mostly in damp forests and ravines up to 5,000 ft.

16.—*Wightia gigantea*, Wall. Vern. *Bop*. (Lepcha). Wood white, very soft and porous. Weight 14 lbs. per cubic ft. Medullary rays uniform, rather broad. Habitat—Eastern Himalaya and the hills of Assam and Burma.

This wood will probably be found too soft for the purpose, and there may be some difficulty in securing a large supply.

17.—*Gmelina arborea*, Roxb. Vern. *Gamar*, *Gambhari* (Bengal). Wood brownish white, soft and even-grained. Weight about 36 lbs. per cub. ft. Medullary rays short, moderately broad, and fairly numerous. Habitat—the moister regions of India and Burma.

It has a fair demand as timber, especially in Bengal, and will probably be found too valuable to use for matches.

18.—*Trewia nudiflora*, Linn. Vern. *Pithali* or *Pithuli Bhurkunda*, (Bengal). Wood white and soft. Weight about 30 lbs. per c. ft. Medullary rays fine, numerous, uniform and closely packed. Habitat—Sub-Himalayan damp forests, also forests of Chittagong and Burma. Common about villages in some parts of Bengal.

19.—*Excacoria Agallocha*, Linn. Vern. *Genwa* (Bengal). Wood very soft and spongy. Average 25 lbs. per c. ft. Medullary rays very numerous and extremely fine. Habitat—tidal forests of India, Burma and the Andamans; very common in the Sundarbans and extensively used in Calcutta for bedsteads and other kinds of cheap house furniture.

20.—*Broussonetia papyrifera*, Vent. The paper mulberry tree of Japan. Vern. *Molaing* (Burma). Wood soft and greyish white, weight about 25 lbs. c. ft. Medullary rays rather broad and short, but fairly numerous. Indigenous in the hills of Upper Burma and Martaban, but it can easily be grown

in Central and Eastern Bengal to serve the double purpose of supplying wood for matches and bark for an excellent paper stock. The growth is fast and the tree produces shoots copiously from stools and roots.

21.—*Ficus hispida*, Linn. Vern. *Dumur* (Bengal). Wood ash colour, soft and somewhat mottled. Weight about 32 lbs. per c. ft. Medullary rays some fine and others broad in long narrow plates. Habitat—Bengal, Assam and the Outer Himalayan forests up to 3,500 ft.

22.—*Populus alba*, Linn. Vern. *Jangli Jrast* (Kashmir); *Mal* (Punjab). Wood white or reddish white, soft, even-grained and elastic. Weight 28 to 44 lbs. per c. ft. Medullary rays very fine, numerous and regular. Habitat—from the Punjab Himalaya westward through Kashmir to Afghanistan and Baluchistan. This tree has already been mentioned. It is undoubtedly one of the best woods for matches, especially for match-boxes.

23.—*Populus ciliata*, Wall. Vern. *Bangikat* (Nepali); *Garpipal* (Kumaon). Wood brownish grey and soft. Weight 25 to 35 lbs. per c. ft. Medullary rays fine, numerous and regular. Habitat—Himalaya from the Indus to Bhutan, 4,000 to 10,000 feet.

The wood of this tree may be found almost as good as that of the last preceding species for matches and match-boxes. For a factory established in Bengal a supply can be obtained from Darjeeling, where another species of the same genus, called *Sungribong* by the Lepchas is also found, the wood of which is expected to be of the same quality.

The following trees, belonging to the Natural Order Coniferae, are commonly known as pines. Some of their nearest allies are very extensively used in Sweden and Germany. Containing resin to a large or small extent, they burn very well and are, owing to the extreme regularity of the structure of their wood, peculiarly well suited to the purpose.

24.—*Pinus excelsa*, Wall. The Blue Pine. Vern. *Tongchi* (Bhutan); *Kail* (Jaunsar). Wood moderately hard, reddish white. Weight about 30 lbs. per c. ft. Medullary rays fine and numerous but rather irregular. Habitat—Western Himalaya and Bhutan.

25.—*Pinus longifolia*, Roxb. The long-leaved Pine, Vern. *Chir* (Hind.), *Gniat* (Lepcha). Wood moderately hard, reddish

brown. Weight 35 to 45 lbs. Medullary rays as in the preceding species. Habitat—Outer Himalaya from Afghanistan to Bhutan.

26.—*Picea Morinda*, Link. The Himalayan Spruce. Vern. *Rai* (Hind.). Wood white, fairly soft, weighing about 30lbs. per c. ft. Medullary rays fine and very numerous. Common in the Himalaya, generally above 7,000 ft. from Afghanistan to Bhutan.

27.—*Abies Pindrow*, Spach. The Himalayan Silver Fir. Vern. *Morinda* (Hind.). Wood white and soft. Weight rather less than 30 lbs. per cub. ft. Medullary rays very fine, very numerous and regular but rather short. Habitat—Outer Himalaya between 7,000 and 9,000 ft., westward from Nepal.

This, as well as the last preceding tree, will probably be found to be the best procurable in India for matches. For match boxes, however, it is feared that they will prove too brittle to stand the usual process of manufacture.

To the above list may be added thick-walled straight bamboos like *Bambusa Balcooa*, Roxb. and *Bambusa Tulda* Roxb. so common in Bengal. The inner soft tissue, when sufficiently dry, burns very well, and the internodes can be split into match sticks most easily, especially when green, without the help of any special machinery.

If match sticks are made out of bamboos, match boxes can also be made of the same material, preferably from the more hollow kinds. These boxes, of course, will be cylindrical instead of the usual rectangular shape. A long internode can be cut up into several pieces of the length of the matches. One of the open ends can be closed with a thin circular disk of any kind of wood to form the bottom, and the lid can be of another piece of bamboo internode plugged by another disk, as made to fit the other end of the tube—somewhat like the wooden cases used in Homœopathic pharmacy. The mixture for the friction surface (phosphorus in the case of safety matches and powdered glass and glue in the case of ordinary friction matches) may be applied on either end of the tube or on a flat surface which can be easily prepared for it on the side. The cylindrical box can be as easily covered with paper and labelled as the ordinary rectangular boxes, perhaps, even more easily.

It is recommended that, if match factory be established in Calcutta or its neighbourhood, trial should first be given to such

local trees as *Simul* (No. 2), *Amra* (No. 7), *Genra* (No. 19) for matches, and to *Kadam* (No. 13) and *Pithali* (No. 18) for match-boxes. If these prove suitable, the expense of obtaining Firs and Poplars from the hills will be saved.

I may add, in conclusion, that, if samples be required of woods that are not locally available, application should be made for them to the Imperial Forest Economist, Imperial Forest College and Research Institute, Dehra Dun, who can arrange to have them forwarded from the nearest source.

## **A BIRD'S-EYE VIEW OF INDIAN SERICULTURE.**

**Babu N. G. Mukerji, M.A., M.R.A.C., & F.H.A.S.**

### **I.—PRELIMINARY.**

GREAT interest has been taken in the subject of sericulture by our Government, by Native States and by private individuals, within recent years, and considerable progress is to be seen in different local areas, which makes it incumbent on us to consider the question of a more general adoption of improved methods and to get a clearer view of the situation as it stands at present. In Bengal, in parts of Maldah, Birbhum, Murshidabad and even in Midnapore (where the industry has almost died out), the silk-rearing peasants now recognise that their salvation lies in the following of scientific methods of sericulture. For the past fifteen years, for instance, more than a dozen cultivators have been using the microscope with success in obtaining seed-crops, and the silk rearers of a village in the Garhbeta Thana of Midnapore, called Uparshol, where a nursery on a scientific basis has been started, have been trying to get a similar nursery started for them at Punishol in the district of Bankura. These two villages exchange seed with each other, and they have come to recognise that the establishment of a seed-rearing nursery in their own village alone is not sufficient to benefit them. For the sake of a parasitic fly, it is impossible in Bengal to rear silkworms successfully for two generations successively, and the people of one district must go to another district, or to a very distant, but recognised, place in the same district for seed. To benefit one part of a country, both parts must be taken in hand at once. This is one of the many examples which shows the importance of understanding the subject, if the cocoon-rearing industry is to be benefited. The starting of nurseries at a haphazard is not enough. We have defects to remedy not only in Bengal, but in Kashmir, in Mysore, in Baroda and in some other parts of India where the industry has been taken up of late years, and where more or less progress has been achieved, notwithstanding faulty application of the scientific system.

2. It is very necessary, therefore, that a succinct and clear account of sericulture should be at hand, which would obviate the necessity in the first instance, of reading up various books and reports that have necessarily sprung up with the 'recent' activities. While I call these activities 'recent,' they are at least 20 years old, and more progress might have been achieved if the improvements had been introduced with sufficient knowledge of the subject. A rude shock is sometimes received, when a party, which has been rearing the Eri silkworms, finds out he ought never to have attempted the task in the particular climate, or where a man who has been trying to introduce the Japanese mulberry, finds out that the tree he has been using is not mulberry at all, but a so-called "paper mulberry" which silkworms never eat, or where a man who has been using the microscope for years in eliminating Pebrine finds out that there is no Pebrine at all to eliminate, or when for years seed, which has been accepted as rigorously "cellular" and free from disease, is found out to be really full of Pebrine. The history of the application of scientific methods in various parts of India, is replete with such examples of mistakes.

3. I do not disparage by any means the literature that has grown up within recent years, and, I may say, the bulk of it is from my own pen; but it is necessary to keep the main points in view with regard to the development of the mulberry, the *tusser* and the *eri* silk industries, and this is my plea for adding more pages to the already existing literature on the subject.

#### II.—CLASSIFICATION.

4. Various classes of silkworms are reared, some indoors and some on trees in the open, which spin cocoons, out of which silk is obtained of various classes. Silkworms fall under two main groups—the Bombycidæ and the Attacidæ. The former make reelable cocoons and the latter unreelable ones, which have to be carded and combed and spun into yarn, like cotton. The mulberry feeding silkworms and the *tusser* silkworms of commerce all come under the Bombycidæ, while the *Endi* silkworms belong to the Attacidæ. The *Attacus Atlas*, which is the largest cocoon of all, out of which come the most magnificent moths, are unreelable and practically worthless wild cocoons.

#### III.—THE MULBERRY SILKWORM.

5. The mulberry feeding silkworms, which are the most profitable of all to rear, are divided into the following groups:—

(1) the *Bombyx mori*, or the annual silkworms reared in Europe, China, Japan, Kashmir and some of the Western Asiatic countries; (2) the *Bombyx textor*, or the Barapalu, the annual silkworm of Bengal, the cocoons of which are flossy and not hard like the *Bombyx mori* cocoons, and the eggs of which do not require such intense cold as the eggs of *B. mori* for their hibernation; (3) the *B. Arracanensis* of Burma and the *Barapát* of Assam which are closely allied to the *B. textor*; (4) the *B. Meridionalis* of Mysore and Kollegal, which yields 7 or 8 crops of cocoons in the year instead of one, the cocoons being greenish white and almost as good as Barapalu cocoons; (5) the *B. Cræsi* (*Madrasii* or *Nistari*), the golden yellow cocoons, which breed eight times in the year in Bengal and which produce very fine and soft silk; (6) the *B. fortunatus* (the *Deshi* or *Chhotopalu*), a brighter yellow cocoon of Bengal containing a larger proportion of stronger silk than the *B. Cræsi* silk; and (7) the *B. Sinensis* or the *China* cocoons, which are the smallest yellow cocoons of all, reared in Midnapore. There is a white variety of *B. Sinensis* also reared in Midnapore, which is called the *Bulu*; (8) the *Theophila* cocoons, found on the mulberry trees in the Himalayas, are wild.

#### IV.—TUSSER SILKWORM.

6. The tusser cocoons are also divided into several groups, of which the *Antheria Yamamai* of Japan, which yields a greenish white silk, somewhat rougher and coarser than white *B. mori* or *B. textor* silk, is the best. The *Antheria pernyi* or the China tusser, comes next. The *Antheria assama* or Muga of Assam is just as good as the China tusser. The *Antheria mylitta* or the Bengal tusser proper, comes last. The tusser of China and Japan is reared on oak-trees. The Muga of Assam is reared on the Suni (*Machilus odoritissima*), the Sualu (*Tetranthera monopetala*), the Mejankuri (*T. polyantha*), the Champaka (*Michelia champaka*) and other trees. The Bengal tusser is reared chiefly on the Assan or Saj tree (*Terminalia tomentosa*), a tree which can be freely pollarded also on *sal*, *arjuna*, *sidha*, *dhah*, *baer*, country-almond and other trees. The moths from tusser cocoons come out very irregularly, specially when the cocoons are large and strong, some coming out within three weeks of their formation, while others may not come out for two years. This accounts for tusser rearers choosing thin and small cocoons for seed, as eclosion of moths from such

cocoons is more regular. An experiment conducted by the author, showed, that large and hard cocoons can be used for seed, if the chrysalids are extracted from the cocoons and kept exposed or buried in saw-dust. This is one important step which can be taken in ameliorating the condition of the tusser silk industry, which is going down on account of disease. The use of genuine wild cocoons for seed is another step.

#### V.—THE BENGAL TUSSEK.

7. There are *three main classes of Bengal tusser*, the Narya, the Daba and the Bugui. (1) The Narya is obtained out of the small sized cocoons, generally wild, though domesticated cocoons are often fraudulently sold as wild cocoons. From the wild or domesticated Dhuria or summer cocoons of June are obtained an Ampatia or flimsy crop of cocoons in July and August, and from this Ampatia crop is obtained the regular crop of the year, the Barsati crop, in October. A Jaddui or cold weather crop of Narya is also sometimes taken; but it takes nearly three months taking a Jaddui crop. (2) The Daba is now always taken from the domesticated stock and not from the wild stock, but it can be taken and ought to be taken from the wild stock, though being the strongest breed of all, the domesticated *Daba* does not give such hopelessly bad results as the domesticated Narya. The origin of the Daba cocoon is probably the Muda Muga cocoon, i.e., the large wild cocoon that does not cut in August or September of the year they are formed, but in the following June or July. In September or October such large and uncut cocoons can be picked out in *kâts* from among pierced seed-cocoons, and they ought to be looked for and reserved for seed till next June, when moths will come out of them, lay eggs as in the case of other tusser cocoons, and give an Ampatia and a Barsati crop of healthy *Dabas*. Some of the largest and hardest Barsati cocoons can be reserved for seed till next June, and the domesticated breed kept on until disease appears among the stock, when the wild stock must be resorted to again, in the manner already described. (3) The origin of the Bugui is the large-sized wild tusser cocoons (called Barra), out of which moths cut out usually in September. It yields one crop of cocoons in November and December. Thus Bugui breeds once in the year, Daba twice, and Narya three times. The cocoons obtained from



October to January, are the best, and those from July to September, are the worst. When the Barsati cocoons are selling from Rs. 8 or Rs. 10 a *kahan* (=1,280 cocoons), the Ampatia *Naryas* or *Dabas* would sell for only Rs. 2 to Rs. 3 per *kahan*.

#### VI.—THE REARING OF THE TUSSER SILKWORM.

8. The method of rearing of all the three classes of tusser cocoons is the same. The moths begin cutting out of cocoons about 4 P.M. At 9 or 10 P.M. the male moths fly away. About 3 A.M. those or other male moths come to the female moths. To facilitate the visit of the male moths, the rearer must keep his females out of doors (usually they are kept perched up on bow-like sticks) and watch them against the attack of bats, birds, lizards, etc. The moths remain paired till about 4 P.M., when they either separate themselves or are separated by the rearer, the females being kept pinned down in leaf receptacles, and the males given to domestic fowls. The eggs are collected after three days, and kept in smaller leaf receptacles, the eggs of two or three moths (about 500 eggs) being kept in each receptacle. On the ninth day the eggs hatch, and as soon as they hatch, they are put out on trees in which they are secured by pinning them on to leaves. The trunks of trees should be brushed clean of ants and other insects, and afterwards they are each given a circle of Bhela oil to protect the worms from the attack of ants, etc. To each tree about half a dozen to a dozen of seed-receptacles are pinned on at different places, that the whole of the tree may get covered with the worms and not any particular part of it only. The trees have to be kept low for facility of watching the insects against ants, wasps, birds, squirrels, a bug called *chánya*, a mantis, scorpions, centipedes, a large carabidæ beetle called *chha-bundia*, and other vermin. In this matter great care is necessary. The principal epidemic from which the tusser silkworm suffers, is Grasserie which is a disease which is produced readily, both among tusser and mulberry silkworms by feeding them with leaf, thinner, i.e., sappier than leaf that the worms have been eating hitherto. As sap rises from the ground, a heavy shower of rain makes the greatest difference of consistency in the leaf in the case of short trees, as by capillary action sap rises to a height of about 4 or 5 feet. No worms should be kept on branches within 4 or 5 feet from the ground, or such branches

should be lopped off from the very first. For tusser rearing the annual pollarding should be so done, that all the branches may be above 5 feet and below 10 feet from the ground, that Grasserie may be avoided, while the worms may be kept under close supervision. Another precaution which may be taken to prevent epidemic, is the daily removal and burial of droppings and dead worms from under the trees. A stick with bird-lime (peepul tree gum mixed up with warm mustard oil and kept covered with a bamboo tube when not in use) ought to be always in the hand of the rearer, that he may effectively scare away wasps and birds. A bow and pellets of mud are also of great help. In tusser rearing localities, one scarcely sees a bird, the watch kept by the rearers being so strict. When the leaf of one tree is eaten away, the branches are lopped off with the worms on them and transferred to another tree, or several trees, and this continued until the cocoons are formed. When the cocoons are all formed, they are brought down with the adhering branches of trees, carefully separated from the branches and sold off in *hats*. When they cannot be sold so readily, they must be killed. For killing the cocoons, they are put inside a *kulsi* (earthen pot), and inside the mouth of the pot a few sticks are inserted, so that when the pot is upset with its mouth downwards, none of the cocoons may fall out. The pot is then put in this reverse condition over another in which water is boiling over an oven. In about half an hour all the cocoons are killed with the steam rising from the one pot and going into the other. They are then dried in the sun and kept for reeling. The effect of domestication of tusser cocoons are:—(1) the cocoons tend to get smaller, (2) they get lighter and lighter in colour, (3) the silk gets finer, (4) the peduncle gets longer and slenderer, (5) the worms get more and more subject to disease. Domesticated cocoons are preferred by weavers, as they produce the whitest and finest cloths.

#### VII.—REELING OF TUSSER.

9. The reeling of tusser cocoons is done by patent processes in the European factories in Bengal, soda or potash being the chief solvent ingredient in use and glycerine the substance for keeping cocoons moist while they are reeled. A single person can reel off the silk from 250 tusser cocoons a day in European factories. The native process consists in boiling the cocoons in water to which ashes of Asan, Kenja, or other tree or plant (such

as linseed plant ashes), are added, or *saji*. For 500 cocoons about half a seer of ashes are used, or half a chhitak of *saji*. A refined method would be the using of lye instead of the crude ashes. The lye may be obtained out of the ashes by repeatedly passing the water through the ashes kept over a piece of calico, until the water looks oily in appearance. The cocoons may be boiled in this lye for about half an hour. All cocoons are not softened equally by the boiling, and those that do not work off easily while they are being reeled, are kept separate and boiled the next day with a fresh lot of cocoons. Large and hard cocoons require stronger alkali and longer boiling. When the cocoons have been boiled, they are kept in a pot between folds of a cloth over some ashes, and reeling commenced at once. One day's cocoons are boiled in the morning, one person being able to reel from 50 to 100 cocoons a day. The reeling is done with a *latai* on the right hand, and with the left hand fibres from 3 to 5 cocoons are twisted on the thigh, while the *latai* is being wound round with the right hand. As 50 to 100 cocoons are reeled and twisted by the same operation per day, this primitive method cannot be regarded as a very ineffective method of preparing the raw material for the loom. Usually the spinning of tussler cocoons is done in the weavers' families, and it is never done by the rearers as it should be. A *kahan* (= 1,280) of cocoons produces from  $\frac{3}{4}$  seer to 2 seers of silk according to quality of cocoons used.

#### VIII.—THE MULBERRY.

10. The mulberry tree grows wild all along the Himalayas, from Kashmir to Assam, and the mulberry silkworm known as *Theophila*, is found abundantly on these trees. The variety of mulberry found in the Himalaya is very large. From the gigantic *Morus serrata* to the dwarf *Morus indica*, the gradation is slow. Some have soft succulent leaf, others rough, spiny leaf; some have large and abundant supply of fruits, others drop their blossoms and are hardly ever known to fruit. Varieties with large-sized leaves set close to one another on stems, smooth, and thick with gummy sap, and bearing little or no fruits, are the best to choose for silkworms. The *Morus alba*, variety *lævigata*, is one of the best varieties to choose. The mulberries in common use in Bengal and Mysore are the *Morus alba*, varieties *indica* and *sinensis*. The former known as *Pheti*

or *Sultani tunt* is the better variety of the two, the gum of the leaf being thicker. It has more palmate leaves, and it requires more manuring and cultivation to keep it in condition. The *Morus sinensis* (the *Kajli* or *Chini tunt*) has thinner and sappier leaves, but it is hardier. It is quite suitable for worms up to their fourth moult, but afterwards, *i.e.*, when the worms are well out of the moult and quite strong, they should be given the stronger *M. indica* leaf. These two varieties do not grow into very large trees, and one of the chief improvements that could be introduced into the Indian industry is the introduction of *M. lævigata* or some other similar superior variety of mulberry, suitable not only for rearing the poor Bengal cocoons, but also the superior *B. mori* cocoons. The tree system of propagation of the mulberry is also more natural and healthy. Trees when once grown up cost little keeping up, while the shrub-mulberry planted 1½ or 2 feet apart costs about Rs. 75 an acre keeping up.

#### IX.—PROPAGATION OF MULBERRY.

11. Propagation of mulberry may be either from seed, or from cuttings, or from grafts. Trees grown from seed produce leaf which, like *M. indica*, is not quite suitable for rearing worms at the last stage. *Morus lævigata*, *M. Philippinensis*, the European *Morus alba* and other superior varieties of mulberry can be readily grown from cuttings, and propagation is done usually from cuttings only. The best Japanese mulberry, however, does not grow from cuttings, and it is grafted. Though the Japanese mulberry answers to all the requirements of a first-class mulberry, it is no better than some of the best Indian mulberries, and there is no occasion to introduce the Japanese varieties into India. For growing any mulberry from seed, one precaution is necessary. Before sowing the seed, it should be put in camphor water in a stoppered bottle for an hour, and then sown. Germination is otherwise very partial. Mulberry seed is smaller than grains of mustard, and seed for a large tract of land can be easily sent through post from one country to another. When the seedlings are grown up, propagation may go on from cuttings, and thus the first cost of setting up a plantation saved very much. When cuttings are available, propagation should be from cuttings. When trees are sought to be propagated, there should be a nursery on high irrigable land, well dug up, manured and cultivated and protected with ditches and fences. The

cuttings or seedlings should be planted in the nursery 9 inches apart, and transplanted on to fields, when 8 or 10 ft. high, at a distance of 20 ft. While transplanting, all the full-formed leaves should be nipped off and all branches within 5 ft. of the ground rejected. Leaf from seedling trees should not be given to worms in their last stage, as it is more sappy.

#### X.—COST OF PLANTING MULBERRY.

12. The cost of starting a mulberry plantation of the shrub kind is about the same as starting a mulberry nursery for trees. In the former case the cuttings are planted about 1½ ft. apart instead of 9 inches apart, and four or five cuttings planted at each spot instead of one. The cost of establishing a mulberry nursery, one acre in area, for the first two years, is given below :—

	Rs.	A.	P.
(1) Wages of 90 men employed in digging the field with spades in the cold weather, at 3 as. ...	16	14	0
(2) Ditching and fencing (by piece-work) ...	30	0	0
(3) Cost of 12 ploughings, the plough-man with bullocks and ploughs being hired, at 4 as. a day ...	9	0	0
(4) Cost of getting 30 loads (about 30 mds.) of mulberry stalks in September, at 4 as. ...	7	8	0
(5) Wages of 15 men making cuttings, at 3 as. ...	2	13	0
(6) Wages of 15 men making hollows in regular lines ...	2	13	0
(7) Wages of 45 men planting cuttings ...	8	7	0
(8) Hand-hoeing in October by piece-work ...	1	8	0
(9) Cutting away the first shoots in December ...	1	8	0
(10) Ploughing afterwards ...	3	0	0
(11) Cost of putting tank-earth as manure in April ...	15	0	0
(12) Ploughing in May ...	2	4	0
(13) Irrigation (if necessary) in May ...	15	0	0
(14) Weeding in July ...	3	0	0
(15) Cutting away of stumps in August or September ...	1	8	0
(16) Ploughing in September ...	1	8	0
(17) Digging with spades after the November bund ...	7	8	0
(18) Two years' rent ...	12	0	0
	141	3	0

Expenditure in connection with items Nos. (10) to (18) has to be incurred annually, i.e., about Rs. 75.

#### XI.—OUTTURN.

13. The first crop of leaf, which is ready in November or December when planting is done in September, or in April when



place, each tree will yield about 10 seers of leaf at each picking, or half a maund in the year. By the tenth year, the yield will gradually increase to a maund per tree. The maximum average yield per tree, may be put down at 2 maunds, which result will be attained after about 20 years. But the divergence in the yield of leaf is great according to the variety grown. The quantities mentioned will be readily yielded by *Morus lævigata*, *Philippinensis* and the ordinary European *Morus alba*, but not by *M. indica* or *sinensis*. Every other year the branches of the trees should be pruned off, so that the new shoots coming on with a more vigorous growth of leaves, can be readily bent, and the leaves picked with the help of a crook without climbing.

#### XIV.—REARING OF SILKWORMS.

16. The rearing of mulberry silkworms and of *Endi* or *Eri* silkworms indoors on bamboo *dalas*, proceeds on much the same method. Leaves (castor leaves in the case of the *Eri* silkworms) are put on the newly-hatched worms, cut up very fine, the worms with the leaves separated from the eggs after three or four hours, and put separately at the lowest shelf of a *machan* (called *gharu* in the silk districts). The eggs hatching the next day are put higher up in the *machan*, and the third day's worms still higher up, after which usually no more notice is taken of the eggs, except in the case of the Barapalu eggs, in which the hatching is much more tardy. The worms, up to the last moult, are usually fed five times a day at regular intervals. At the last stage, the worms are fed three or four times a day. The worms moult or change their skin four times during this interval, *i.e.*, from hatching to spinning of cocoons. Inside the cocoons the worm moults twice, once in changing into chrysalis and the second time in changing into a moth. Inside the cocoons and as moths they eat nothing. As moths they pair and lay eggs, and after a few days die off. Strong and healthy moths may live for a fortnight after laying eggs; but a moth dying within a day or two, after laying eggs, *may be* healthy and their eggs fit for rearing. As leaves are heaped up on *dalas* by repeated feeding, cleaning becomes necessary. Native rearers neglect cleaning at least in the early stages. But neglect in this matter and in the matter of keeping the worms thin, and the room well ventilated (though the worms themselves must always

be kept away from a current of air), result in worms dying in large numbers specially at the last stage, though at the last stage one may be very careful. Keeping the worms thin and clean and the room well ventilated (though in even temperature) and free from dust, is necessary from the first. Cleaning and thinning of the worms are facilitated by thread-nets of meshes of about half an inch. A net is spread over the worms resting on dirty leaves, fresh leaves (cut up fine at the two early stages and whole leaves with stalks being put from the third stage) scattered over the net, and after half a minute the net may be removed to another *dala*. This has the effect of separating the worms evenly into two lots. Nets are to be used daily for cleaning, whether the worms need thinning or not. A *dala* of newly-hatched worms has to be divided up into three *dalas* after the first moult, into nine *dalas* after the second moult, into 27 *dalas* after the third moult, into 81 *dalas* after the fourth moult, and at the last stage the worms occupy twice as much space (i.e., 162 *dalas*) before they make cocoons. Daily the net from a *dala*, with the worms and litter, are to be lifted at the mid-day feed, removed on to a fresh *dala*, and the older *dala* removed outside and thoroughly cleaned. If, however, worms are found underneath the net, they must be assumed to be moulting. They should not then be disturbed, but kept on a lower shelf on a separate *machan* where no feeding should be done for about 24 hours. The worms on the net removed to a fresh *dala* are to be given a feed and then left without food for about 24 hours. Great care is necessary at moulting periods. The point to remember is, it does more harm giving food to moulting worms than fasting them for a few hours until the worms are well out of moult which is known by their agility and hungry look. If, on blowing over the worms, they move very fast, one knows they are properly out of moult. If, on the contrary, the movement they exhibit is of a dull and listless kind, they are not quite out of their sickness, and they should be still left without food. An extra feed at the time when the worms are going off to moult does not do them much harm; but feeding too early does harm. Experience is needed in this matter.

17. Worms in the same room should be all of the same age, as much as possible. That is why tardy worms are kept high



upon *machans*, and early ones lower down, both at hatching and at moulting times. If worms of different ages are kept in the same room, the late worms suffer more from disease. Worms, when they are ready for spinning, become translucent, and they constantly spit out silk from their mouth. At this time, in the case of Indian silkworms, they are quickly picked and transferred to a spinning screen (or *chandraki*), where they get convenient bearings for making cocoons. In the case of the *B. mori*, dry twigs are arched over the worms and ripe worms make their cocoons in these arches. In the hot weather, from hatching to spinning, only about 20 days are spent in the plains of Bengal, and in the coldest weather about 40 days. But cocoon-rearing is best done when the temperature is about 75° and fairly uniform. That is why the November bund or crop is the best crop, and the March bund the next best. If large mulberry leaves are used, only these two crops would be taken. But when the shrub mulberry is used, rearing must be done at other seasons also, when, on account of too great heat, or cold, or damp, rearings are more or less unsuccessful. Two good crops of cocoons are better than eight indifferent ones (even the two good crops being subject to infection when four or eight crops are attempted). Indeed, on account of the parasitic fly-pest, it is not feasible to take all the eight crops in the year, and this is why rearers take a crop and omit the next and then go for seed to some distant place, and then the actual number of crops taken in a village is three or four. When the cocoons are formed, they are gathered from *chandrakis* on the third day and sold off at once, or killed in a *kulsi* as described in connection with tusser cocoons, or in a basket put over a boiling pan of water, the basket being covered over with a blanket. When there is hot sun, the rays of the sun are sufficient to kill the cocoons in two or three days.

#### XV.—REELING OF MULBERRY COCOONS.

18. Except in the rainy season, cocoons, however killed, must be steamed in an oven immediately before reeling. Ovened cocoons should be reeled off within 3 or 4 days. Ovened cocoons should not be spread out in the sun to get dry, but should be kept spread out indoors in *machans* and reeled off as fast as possible. For small quantities of cocoons the ovening can be done in a basket over a pan of fire as in the case of killing, a blank space being left in the middle of the basket, so that cocoons about 6" thick

may rest on all sides and the top, and the steam works its way from the bottom through the cocoons and out of the blanket. When for 10 minutes the steam is coming out of the blanket, the cocoons may be considered to be properly ovened. When dealing with large quantities of cocoons, special erections are necessary for ovening. In the rainy season the air is naturally steamy, and it exercises the same beneficial effect on the cocoons as an artificially produced atmosphere of steam. But cocoons *spun* in rainy weather do not unravel properly in basins, and they are a source of great loss to European factories where even silk is required to be made. Ovened cocoons are reeled off in a basin of water which is kept boiled with fire or steam, and passed in two lots to a reel, which as it is wound round and round, the cocoons get worked off. As each cocoon gets worked off, its place is supplied by another, the end of which is kept ready for the purpose by the reeler, and an expert reeler can reel off as many as four *kahāns* of cocoons per day when he has to make the best kind of silk, and ten *kahāns* a day when he has to make native *Khangru* silk.

#### XVI.—THE SILK-FIBRE.

19. There is no fibre so long, so strong, so fine, so soft, and so smooth as the silk-fibre. When we talk about the staple of cotton-fibre being long, we only mean that it is  $1\frac{1}{2}$  or  $1\frac{3}{4}$  inches in length; when we talk of jute-fibre long, we only mean that it is 12 or 13 ft. long, but the tusser cocoon has an uninterrupted fibre 800 yards long and some varieties of mulberry cocoons, one uninterrupted fibre of 900 yards, and yet the fibre is so fine that in the case of the tusser this single fibre from a cocoon is 700 milligrammes and in the case of the mulberry silk it is 250 milligrammes in weight. So fine is the thread, that although there is no difficulty, on account of its strength, to draw the thread out of single cocoons, in practice never fewer than three cocoons in the case of the tusser and never fewer than four or five in the case of the mulberry cocoons, are used simultaneously for drawing out the thread from. It is for the finest silk muslins or silk gauze that thread is made by drawing out the fibre of four or five mulberry cocoons together. So strong is the fibre of mulberry cocoons that it is quite easy to draw out the fibre on to a reel without a single break, though this fibre is so fine that, for practical purposes, it is never used for making fabrics in these days, though

perhaps in olden times, the "Koan vests" of the Roman Empire were woven out of such single silk-fibre. And yet each single fibre of silk is made of two ultimate fibres agglutinated together with a natural gum which gives the fibre its brilliancy. These two ultimate fibres or *baves* come out of the spinarette at the mouth of the silkworm, and are ultimately derived from two glands situated on two sides of the interior of the worm. These two glands are sometimes taken out of the body of the silkworm, put in vinegar and afterwards drawn out in the form of silkworm gut, which is used for tying fishing hooks to the line. For its weight and pliancy there is no such strong substance as the silkworm gut.

20. But though the fibre is the strongest, finest and softest fibre of all, one silk-fibre differs from another so much that one is valued at Rs. 10 a seer, while another at Rs. 30 a seer, and a country which habitually deals with a Rs. 10-per-seer fibre can ill-compete with a country which habitually produces a Rs. 30-per-seer fibre. The native-made silk of India called *Khangru* or *Ghangru* silk sometimes sell at only Rs. 10 per seer, and Rs. 12 per seer may be taken as the average price of *Kangru* silk. The European filature reeled silk is much better. It sometimes sells for only Rs. 16 or Rs. 17 per seer, but its average price is about Rs. 20. Italian, French, and Japanese silks are still better and they sell for about Rs. 30 a seer.

21. Why is there this difference in price? Let us first see the cause of difference between European filature reeled silk and *Khangru* silk. As much as one seer a day may be reeled by a couple of men on the *Khangru* system, though the average quantity is 9 chhitaks. As much as  $4\frac{1}{2}$  chhitaks per day is sometimes turned out by a pair of operatives in European filatures, but the average may be taken at  $3\frac{1}{2}$  chhitaks. This difference comes of the Europeans looking to quality and the Indians chiefly to quantity. There are three causes which combine to make the European filature reeled silk so much superior to the country *Khangru* silk:—(1) The European factories of Bengal regulate the number of cocoons reeled more exactly and usually use a smaller number, five or six cocoons, instead of 20 cocoons. (2) The European factories insist on a knot being put whenever there is a break. (3) The European factories cross two adjacent lots of fibre twice on themselves to effect an aggluti-

nation of fibres, while the country reelers not giving any croisure and putting no knots, can reel away very fast and get a larger absolute and relative produce.

22. Is it worth while for our country reelers to follow the European system, and produce a smaller quantity of superior fibre? Not at present, when the demand for silk at Rs. 12 a seer in India is very large and very keen. There is practically no demand for the Rs. 20 silk in the Indian market. Ask the large silk mill-owners of Bombay what silk they want. They will tell you, silk of the value of Rs. 5 or Rs. 6 per pound; and as for hand-loom use, they prefer, as a rule, the cheaper silk. A few *skeins* of what is called by our country weavers "Latin silk," that is, European filature reeled silk, are always used by exceptionally good weavers to meet some special demand, but it is the *Khangru* silk that they are accustomed to handle. The demand from Benares, Lahore, Amritsar, Karachi, Nagpur and other centres of silk-weaving is for the Bengal *Khangru* silk, and this demand is very great. Nearly a crore of rupees worth of silk is exported to other Provinces of India from Bengal against 50 lakhs of rupees worth of superior filature reeled silk exported to Europe and America. The demand for the *Khangru* silk shows an upward tendency, and the demand for the superior European silk shows a downward tendency. There is, therefore, no hesitation in what I have recommended. Go in for quantity *for the present*, and turn out *Khangru* silk for the country.

23. The next question we should turn our attention to, is, why is not the European filature reeled silk of Bengal as good as Italian, French or Japanese silk? In Europe there is demand mainly for high-class silks, as in India there is demand chiefly for low grade and cheap silks; and in India also, as time goes on, the demand for high class silks will increase. If the millers and weavers of India can buy high class silks for Rs. 8 per lb., they will not buy low grade silks for Rs. 5 or Rs. 6 per lb. High class silks are more easily unravelled, and there is less waste in unravelling it, and though labour in India is cheap, the manufacturer finds it pays him to buy high class silk for Rs. 8 a lb. If in Europe also European filature reeled silk can be sold for Rs. 8 a lb., it will sell better, but European manufacturers do not care about using silk which gives so much trouble in un-

ravelling. It is therefore, worth while to be prepared for the European market and for the future demand of the Indian market. At present the European silk factories should re-wind their raw silk before export.

24. What is the cause of the inferiority of the European filature reeled silk of Bengal as compared to the European and Japanese silk? This is a question which we have not answered yet. From recent experiments I have come to the conclusion that the inferiority comes neither from the inferiority of the workmen nor of the machine, but it is to be attributed mainly to the inferiority of the Bengal cocoon. The Bengal cocoons are the worst in the world, and with no machine is it possible to produce out of these cocoons silk of such quality as can be produced out of the *Bombyx mori* cocoons. The reason is not far to seek. The length of the fibre on a Bengal cocoon is about 200 to 250 yards, while that on a *Bombyx mori* cocoon about 800 yards. The silk made out of *Bombyx mori* cocoons (which are the staple of Europe and Japan) must, therefore, contain about four times as fewer joinings as the silk made out of *Bombyx Cræsi* or *B. fortunatus* cocoons of Bengal. The average length of fibre on a Mysore cocoon is about 300 yards, and the *Bombyx meridionalis* cocoons of Madras, therefore, produce a little better silk than the silk produced by the same machine in Bengal filatures out of Bengal cocoons.

#### XVII.—INTRODUCTION OF THE *Bombyx Mori* COCOONS.

25. How to introduce the *Bombyx mori* cocoons into India is, therefore, the problem before us. I have worked the *Bombyx mori* cocoons successfully for a number of years in Bengal, and it has been worked in Kashmir and Assam with success also. The difficulty with regard to the rearing of this class of cocoons is in the matter of conservation of seed or eggs. The eggs require a period of intense dry cold, and they must be protected from hot winds at other times. In every part of India the *B. mori* worms can be reared (and in many parts they have been reared), successfully at some time or other from February to June. But the conservation of the eggs from April to next January is possible only in a few places like Kashmir, Dalhousie, &c., where in winter the cold is severe but dry. There is another difficulty with regard to the *B. mori*. The epidemic called Pebrine must be kept suppressed by annual examination

of the seed. with a microscope. If railway communication is established between Kashmir and the rest of India, and if Kashmir establishes the "system of grainage" as devised by M. Pasteur, she can supply the rest of India with seed. This will give one good crop in the year which will make a Rs. 30-per-seer silk. But a separate organization of having a grainage and hibernating station at Dalhousie may be also tried, and this was the subject of my paper in last year's Conference at Benares.

XVIII.—DISEASES OF SILKWORMS.

26. The greatest obstacle to sericulture is the prevalence of certain diseases among silkworms. In Bengal, Pebrine Muscardine Grasserie, and the fly-pest (*Tricolyya bombycis*) do the greatest amount of damage; while other diseases, such as Flacherie, Court, Gatine and the *Dermestes vulpinus* also do some amount of harm. In Mysore Flacherie does the most harm, while other diseases are scarcely known.

27. Pebrine (Bengali *kata*) is caused by a microscopic organism which, when magnified 600 diameters, looks like grains of mung seed. It is a slow-acting disease, taking 30 days for complete development, so that when the seed is badly pebrinized, the worms die off at the last stage, all of a sudden. If rearing is completed in less than 30 days, pebrinized worms spin cocoons, though these are poor. When the seed is not very badly pebrinized, some worms, i.e., those produced from pebrinized eggs, die off on the 30th day, while others which catch the infection from the pebrinized worms, die later on, or make cocoons and come out as moths, which show pebrine corpuscles, and then die. Some worms from eggs, free from pebrine, happen to escape infection. These spin cocoons, come out as moths, and show no pebrine corpuscles. The eggs from these moths are safe to rear from. Each moth is made to lay eggs under a separate cover, on sheets of paper, and after at least five days, each is examined under a microscope. The eggs of those moths, the blood of which show no pebrine corpuscles, are retained, the rest being burnt. The eggs selected out are then superficially purified from diseases, by a dip in a sulphate of copper bath ( $\frac{1}{2}\%$  solution), hung up in a cool but airy place to get dry, and then taken inside a rearing room, which, with its rearing appliances, has been already disinfected with sulphate of copper wash and sulphur fumes. The

rearing from eggs thus selected, and in room thus disinfected, cannot fail from pebrine. Where rearing takes place once a year, disinfection of appliances is not necessary for protecting the worms against pebrine alone, provided the seed itself is selected. The germ of pebrine loses its vitality in seven months, and local infection thus dies out before the next annual crop is taken. Natural freedom from pebrine is more desirable than freedom secured by microscopic selection. Thus, the *Bombyx meridionalis* silkworm of Mysore is naturally free from pebrine, and microscopic selection is not necessary in rearing, and this variety is giving good result in Bengal. A lot of seed selected out free from pebrine always tends again to get more and more pebrinized from 1 to 5%, from 5 to 20%, and from 20 to 50%, and so on, until in a few generations every moth again is found to be pebrinized. In this case, therefore, microscopic selection is needed at every generation to secure exemption from pebrine. Five per cent. of pebrine in the seed does not affect the result, but 20, 30 or 50% of pebrine left without selection, spoils the result more or less, though even with 80 or 90% of pebrine in the seed, a sort of a crop is obtained in the hot weather, the pebrine not getting time to develop so fully as to kill the worms. It only weakens the worms, so that they either make poor cocoons, or succumb to other diseases. A pebrinized lot of worms thus falls an easier victim to Flacherie Muscardine, Grasserie and Court, than a lot of worms which is free from pebrine. It is essential to have a number of nurseries in each silk-district in Bengal, where the system of microscopic selection will be rigorously followed and the cocoons obtained from selected eggs sold for seed purpose, or where a stock naturally free from pebrine is reared. The few nurseries that have been established by cocoon-rearers in Bengal are doing very good work.

28. Muscardine is another epidemic of the silkworm which is due to a higher fungus, quite visible to the naked eye in its fully developed form when it partakes of the nature of a white mould on the bodies of dead worms. The worms which have this mould get like sticks of lime, hence the Bengali name *Chunakati*. This epidemic is also readily controlled by disinfection of eggs and all the appliances used, and rearing the worms in clean manner. If, through neglect of disinfection of the rearing house and the appliances, of the eggs at the commencement,

or by the neglect of delitage, Muscardine does break out, it can be stopped, by cleaning the worms with nets, keeping the worms fasting for a few hours and by burning sulphur afterwards in the room, thoroughly shutting it up. The cleaning will have to be done daily after this, and a little sulphur burnt, after the room has been smeared with sulphate of copper solution. Many a rearing was saved from Muscardine in connection with the experiments with which I was entrusted for ten years.

29. Flacherie is an epidemic caused by the fermentation of mulberry leaf inside the stomach of silkworms. Such fermentation may be caused by various microbes, but the microbe which is mainly instrumental in setting up the gastric fermentation is the *Bacillus Megaterium bombycis*. The disease is known in Bengal as Kalsira, because the dorsal vessel of the worm gets black. Putrefaction, however, sets in very rapidly and the whole worm gets black and putrid soon after death. This disease is so common in Mysore, because there the custom prevails of feeding the worms 7 to 9 times a day instead of 3 or 4 times. The organism may be either in the spoilt, dusty or heated mulberry leaf, or in the intestine of the silkworm. Weak worms have greater proclivity to take the epidemic, so that a feed of the same lot of mulberry may give Flacherie to one rearing and none to another. The state of the rearing room also has considerable effect on the disease. A stuffy, close room would give Flacherie to silkworms, while a well-ventilated room gives comparative immunity. Dust, specially dust raised at delitage, aggravates the epidemic. The remedies are: (1) disinfection of eggs, rearing house and appliances with sulphate of copper solution. (2) Feeding of the worms not more than five times during the early stages and not more than four times a day during the last stage. (3) Using of fresh unfermented leaf, without dust, without dew or other moisture, and of leaf that has not been submerged under water or otherwise got under the control of microbes in the field while growing. (4) Keeping the rearing room well ventilated. (5) Cleaning the worms daily and yet raising no dust, by taking the trays out for dusting, and keeping the floor instead of sweeping it.

30. Gatine (Bengali *Salpha*) is a form of indigestion which is caused by excess of heat or excess of cold, which takes away the appetite of the worms, and though they are given leaf, they



do not eat, or eat only occasionally. The worms look elongated and white. In pebrine also the worms look pale, but they look short and not elongated. The ultimate form which Gattine takes is the same as in the case of Flacherie. They become black and putrid. Gattine, however, is not so fatal, and it does not spread so rapidly as Flacherie; and if the worms are removed from the cold place, or if by *punkha* or other means heat can be lessened, the worms recommence eating and the epidemic is arrested. It is best to avoid rearing in April or May, and in December and January, when the temperature cannot be controlled, and rearing in open places, where the temperature varies very much.

31. Grasserie (Bengali *Rasa*) is a disease which is not associated with any microbe. It is caused by a sudden change in the character of food from a less sappy to a more sappy condition. Worms ought to be given stronger and stronger leaf as they get older and older; but if, owing to a heavy shower of rain following protracted drought, or change of field, the consistency of leaf changes into a more sappy condition, Grasserie at once breaks out. The remedy is to use leaf gathered from trees and eschew the use of shrub leaf as much as possible. The recommendation to grow large mulberry trees is very important for this among other reasons. In Europe and in Kashmir where leaf from trees is used, Grasserie is never known in the epidemic form, while in Bengal more loss takes place from Grasserie than from Flacherie. In fact, Grasserie is looked upon by the French peasant as an auspicious sign, as an indication of a full harvest.

32. Court, called in Bengali *Lali*, *Rangi* or *Kurkutte*, is more an abnormality than a disease. A worm affected with *Court*, turns into chrysalis without making a cocoon or making a very flimsy one. The chrysalis turns into a moth which may lay eggs, and examined under the microscope, it may not show any disease. But the reproduction from such seed gives *Court* in a more exaggerated form in the next generation, and it is, therefore, an abnormality that must be avoided. If worms are fed on *naicha* leaf, that is, on leaf from a new plantation, or from shady places, or given an insufficient supply of leaf at the last stage, this abnormality is noticed and it is further hereditary

33. Double-cocoon (Beng. *Genthe-koa*) or two worms jointly forming one cocoon, is an abnormality which is not very common

in Bengal, but it is very common in Japan and China, and fairly common in Europe. The tendency is hereditary, and as double cocoons cannot be reeled, they are often fraudulently used for obtaining seed for sale. The use of such seed has resulted in breeds that show the abnormal tendency to an exaggerated degree. In Bengal, cocoons being always bought for seed, there is no fear of this abnormality assuming alarming proportions.

34. The fly-pest does very great harm to the silk crop in Bengal. The *Tricolyya bombycis* which is a tachinid fly, lays its eggs only on silkworms. The eggs hatch into maggots which penetrate into the body of silkworms, and in time kill the silkworms either before or after they have made cocoons. If a silkworm dies after making its cocoon, instead of a moth, a number of maggots of the fly come out of the cocoon. These infest the rearing room, and it becomes impossible to rear silkworms at the next generation. That is why Bengal rearers give up rearing every other generation, and every time go to some distant place for seed. With the seed-cocoons, however, a few maggots of the parasite always come into the village, and some damage is always done. The remedies are: (1) For all the villagers to seed their cocoons in the distant village where they go to buy them, and bring home only eggs. (2) Never to allow any villager to take two crops in succession, but to make all to stick to the three or four regular crops. (3) If these precautions are impossible to adopt and if the fly must be dealt with, the rearing room must be built in a special manner, the windows away from the entrance being fitted up with wire gauze, and outside the windows vessels of water with a few drops of kerosine oil to each being kept at a height of 5 or 6 feet from the ground, while before the entrance, which should be kept shut in day time as much as possible, cow-dung fire should be always kept, which should evolve smoke. This has the result of the parasitic fly avoiding the entrance, congregating outside the windows and rushing every now and again into the troughs of water and drowning themselves, believing them to be entrances to the rearing room.

35. The *Dermestes vulpinus* is a beetle which eats up silkworms, chrysalids and moths, both in the larval and imago stages. These also come with the seed-cocoons. They also harbour in cocoon godowns. If seeding is done outside rearing rooms, and if the rearing rooms and appliances are kept scrupu-

lously clean, there is no fear of loss in an epidemic form from this pest. Once only has the author seen the *Dermestes* ruining the rearings in a few villages near Berhampore.

36. The Eri silkworm is reared in the same way as other Polyvoltine silkworms of Bengal. The cocoons, however, cannot be reeled, and the method of dealing with the cocoons should therefore, be described. The moths should be allowed to escape from the cocoons, and as in reeling mulberry or tusser cocoons, the insects should not be allowed to remain in the cocoons. The rearing and spinning, therefore, of the Eri silkworm involves no killing of animals, and for this reason alone Eri silk-rearing is popular among amateurs in this country. The fibre also is strong, and *Endi* cloth is on this account very popular, and the rearing of the Eri silkworm, though less profitable than that of mulberry or tusser silkworm, is not altogether without advantages. The cocoons, after the moths have escaped from them, are boiled with ashes or better still with lye, as in the case of tusser cocoons, and when cool, well kneaded in the warm lye, and then washed by constant kneading in clean water, wrung out and dried in the sun and spun with a spindle or a wheel at leisure. Eri rearing and spinning must remain for years to come a cottage industry. But Eri cocoons are carded and combed and spun like cotton or wool in European mills, and when the industry is established on a large scale anywhere, a *carderie* on European principles may be established.

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## THE JUTE CROP OF INDIA.

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THE modern jute industry of Bengal may be said to have had its origin in the year 1828, when exportation to Europe commenced. Before this time considerable quantities of the fibre were undoubtedly produced, but the entire output was consumed locally. A footing having been once established in the European market, the value of the fibre was immediately recognized, and the expansion of the trade, has ever since, been constant and rapid.

In a recent article which appeared in the *Times* of London, jute was described as one of the great assets of the Empire, and most certainly it is a most valuable asset for it brings money to our Indian cultivators, to numerous Indian and European dealers, to merchants and ship-owners, and to a host of manufacturers both in Calcutta and Dundee. The demand for jute, in spite of the remarkable expansion in its cultivation in recent years, and the rise of prices to an unprecedented height, still continues to be very keen, and consumption at the present day is very near to outstripping production. Not only are old markets asking for increased supplies, but new ones are continually opening out. And jute fibre is further being put to an increasing number of uses every year.

The importance of jute in the sphere of commerce may be gauged from trade reports, which reveal the fact that the exports of raw and manufactured jute constitute one-fifth of India's total exports. Taking the two Provinces of Bengal and Eastern Bengal and Assam, from where practically all the jute of India comes, it may be noted that the outturn has risen steadily from 65½ lakhs of bales (of 400 lbs. each) in 1900, *i.e.*, about 325 lakhs of maunds to over 85 lakhs of bales, *i.e.*, about 425 lakhs of maunds—the estimated outturn of the crop for the

present year. The total consumption which includes exports, mill-consumption and country consumption, has also similarly risen from 65 lakhs of maunds in 1900 to 81 lakhs in 1905. The consumption this year, will no doubt show a further increase. Side by side, with an increase in production, the jute industry itself has developed enormously in this country; the number of looms at work having increased from 9,841 in 1896 to 23,884 in 1906, and the actual consumption of jute by the mills has doubled during the last ten years.

To pass on to the financial aspect of the jute trade, I do not think that I would be wrong in stating that prices also have doubled during the last ten years. During 1905-06, the average price per bale of 400 lbs. was Rs. 46 and no less a rate than Rs. 70 per bale is also reported to have been paid by purchasers during that year. What is believed to be the highest price on record is the phenomenal price of Rs. 85 per bale which was recently paid for a small parcel of Dacca jute of quite exceptional quality. The transactions of the jute market this year may be expected to disclose that about 37 crores of rupees are likely to change hands, as a result of the general cultivation of the jute crop in Bengal and Eastern Bengal and Assam and of its very limited cultivation in Cooch Bihar, Nepal, Madras, and Upper India.

It has been estimated, that jute agriculture brings in over 21 crores of rupees to the growers, and it may bring in as many crores more in another ten or twenty years, if there is the same expansion in its cultivation as there has been during the last decade. The increased payments to cultivators of jute, caused by the rise in price during recent years has amounted to several crores of rupees. They are making very large profits over the crop, and all Bengal *ryots*, whether jute growers or cultivators of other crops, cannot, therefore, but be deeply concerned in its improved cultivation.

There is still ample room for the extension of its cultivation, and there is decidedly a necessity for improving its quality. Complaints have been frequent of late regarding the deterioration of jute fibre, and it is for the cultivator to rise to the occasion and to remove this defect. Otherwise, the industry is likely to suffer in the near future. If the manufacturers of Europe and America do not get better stuff than what is being sent to

them at present, they will surely turn their eyes to other markets than ours.

At present, the seller seems to be quite certain of a market for his fibre, even though it is of inferior quality and adulterated, but he should open his eyes to the fact that in Java, French Indo-China and West Africa, continuous and in some cases successful efforts are being made to introduce the cultivation of jute. Of course, another solution of the dilemma presents itself in adopting other possible substitutes for jute, such as *San hemp* (*Crotalaria juncea*), *Patua* (*Hibiscus cannabinus*) Dhainche (*Sesbania aculeata*), American aloe (*Agave americana*), Murvi (*Sansevieria Zeylanica*) *Akanda* (*Calatropis gigantea*), Ramie or Rhea (*Bohemia nevea*), *Flax* (*Linum ussitalissum*),—but more is known of the capabilities of jute than of any of the other fibres. Therefore, at the present time, the cultivator may well be exhorted to look to his jute and jute alone.

There are various causes which lead to the degeneration of jute, such, for example, as the actual degeneration of the plants grown for fibre, the growth of the crop on unsuitable soils, the use of inferior seed, the cultivation of varieties of jute, which are unsuitable for the particular locality in which they are grown, the want of proper cultivation and of judicious manuring, carelessness in the preparation of fibre for the market and last, but not least, the fraudulent adulteration of the produce in order to increase its weight before bringing it into the market—a notorious and wide-spread malpractice, which is bringing a valuable staple into disrepute in foreign markets, and is damaging the common interests of the trade.

Some hints and suggestions are now added which will be of help to those already employed in jute cultivation in turning out better crops. They also provide sufficient instructions to those who may feel disposed to take up the growth of jute as a fresh industry.

The hints are supplied under various headings to admit of easy reference and study.

(a) *Botanical description, Vernacular names and varieties.*

—Jute belongs to the natural order *Liliaceae* and to the Genus *corchorus*. The commercial fibre jute is obtained from the two species known as *Corchorus capsularis* and *Corchorus olitorius*. The former, which has rounded fruit pods,

can stand water logging and is very largely cultivated in Eastern and in parts of Northern Bengal. The latter, which bears long cylindrical pods does not thrive on low lands subject to floods. It is grown to a much more limited extent, being found chiefly on the higher lands towards the south and west. Both the above plants are annual. The flowers vary from a whitish yellow to a yellow colour. The capsules are five-celled, but white *Capsularis* has no transverse partitions, *Oltorious* has numerous transverse partitions between the seeds. The tap root of *Cap-sularis* is thick, while that of *Oltorious* is long and tapering. Some of the varieties of each of the above two species have red stems and others green stems.

Experiments made by the Agricultural Department of Bengal tend to show that the green-stemmed *Capsularis* is more prolific than the red-stemmed, while quite the reverse is the case with *Oltorious*. There are various vernacular names by which the jute crop is known in Bengal, e.g., *pat*, *koshta*, *nalita*, *jhouto*, *nalta*, *narcha*, &c.

(b) *Area Sown*.—Before the Partition of Bengal, the forecasts of the Agricultural Department of the Province dealt with the jute crop grown in 27 districts. The area under jute in these districts, amounted to 3,144,600 acres. Thirteen of these districts having been transferred to the new Province of Eastern Bengal and Assam, there are at present only 14 jute growing districts left in the Province. They cover an area of 780,400 acres. The 27 districts referred to above with the land under jute before the Partition were as follows:—

District.	Acres.
Mymensingh ...	795,200
Rangpur ...	385,000
Purnea ...	269,000
Tipperra ...	246,800
Dacca ...	210,100
Pabna ...	200,600
Bogra ...	135,000
Faridpur ...	134,000
Rajshahi ...	128,000
Dinajpur ...	125,000
Jalpaiguri ...	108,100
24 Parganas ...	89,900
Howrah ...	51,000
Nadia ...	45,000

District.	Acres.
Jessore	41,300
Murshidabad	40,800
Malda	31,600
Backergunge	18,000
Bhagalpur	17,900
Hooghly	15,800
Burdwan	14,500
Khulna	10,700
Midnapore	10,500
Cuttack	10,200
Noakhali	4,200
Balasore	4,200
Darjeeling	2,200

And the 14 jute districts now of Bengal Proper are :—Burdwan, Midnapore, Hooghly, Howrah, 24 Pargnas., Nadia, Murshidabad, Jessore, Khulna, Bhagalpur, Purnea, Darjeeling, Cuttack and Balasore.

The consolidated acreage of the crop given above for the two Provinces does not include the jute areas in Cooch Behar, Nepal, Madras and Upper India, which showed the following outturn in 1905 :—

	Bales.
Cooch Behar	52,800
Nepal	64,302
From Upper India via E. I. Railway	26,269
From Stations outside Bengal-Nagpur Railway.	4,257

The cultivation of jute has commenced also in Bihar, which at present accounts for only a few thousand bales—(*The Agricultural Department of Bengal has done much to introduce the cultivation of the fibre in this part of the Province, and results attained have been highly encouraging, and it is hoped that jute will become quite an important and profitable crop of Bihar.*)

(c) *Soil.*—Jute is a most accommodating crop, being capable of cultivation on almost any kind of soil. It is found growing on clayey homestead lands as well as on high loams, where autumn paddy is generally cultivated. It gives a good return on alluvial soils, and is cultivated also on low lands where water accumulates to a depth of 1 to 5 feet. It grows also on the salt-impregnated soil of the Sunderbans. It is most productive on a rich loam. *Laterite and gravelly soils are not suited to its cultivation.*



(d) *Climate*.—Sufficient moisture, without excessive rain, and a high temperature, especially in the early part of the season, are necessary for successful cultivation.

(e) *Rotation*.—As is the case with other field crops, cultivators do not follow any fixed rotation with jute. It has, however, been found that it does very well after pulse crops on uplands. It is often sown after *aus* paddy and grows well in rotation with the *aman* paddy and potatoes also. Jute is sometimes grown after jute without any intervening crop, but this practice is to be condemned. In some places, *San* hemp is grown as a preparatory crop, and this rotation is recommended.

(f) *Preparation of the Land*.—When the crop is cultivated on low lands, which are liable to be submerged by early floods, the field should be ploughed early in the cold weather, so that it may be ready for sowing in March. It is a bad practice to give the first ploughing just before sowing in February or March. Altogether some five ploughings will be found sufficient, given at intervals of a week. Care should be taken to pulverise the land thoroughly, as a deep and fine tilth is most essential for the proper growth of the crop. At the final ploughing, care should be taken that all weeds are uprooted and removed.

(g) *Manuring*.—On lands, where silt is deposited during the rains, no manure is required for jute, but on other soils, cowdung may be used with advantage, as from experiments it has been found to be the best and cheapest manure for this crop. Manure experiments with jute at the Burdwan Experiment Station extending over a period of 12 years, have shown that cowdung gives better results than such manures as castor cake, bonemeal, saltpetre and superphosphate. Green manuring with *San* hemp or some other leguminous crop is also strongly recommended.

(h) *Selection of Seed*.—As a rule, very little attention is paid by *ryots* to the selection of good seed. This is to be much regretted. Ordinarily, a few plants are left to ripen in a corner or on the border of the field, and seed is taken from these for the following year's sowing. The paramount importance of selecting the most vigorous and best developed plants for seed cannot be too strongly impressed upon cultivators. The seed, when collected, requires to be very carefully stored for the next sowing. It should be kept in airtight vessels. In choosing seed, it is

advisable to select a green-stemmed *Chapeularis* variety or a red-stemmed *Olitorious* variety.

From results obtained so far from the experiments made at Burdwan of the former, *the Deswal of Serajganj, Baran of Mymensingh, Kakaiya Bombai of Serajganj and Amonia of Faridpur*, and of the latter the *Tosha of Pabna, Satnalla of Faridpur*, and *Halbilabi* varieties are worth the cultivator's attention.

*Jute seed may be indented for through District Agricultural Associations from the Agricultural Department, Bengal.*

(i) *Sowing.*—As has been already stated, the sowing season generally extends from about the middle of March to the end of April. Later sowings are sometimes done. The land having been thoroughly tilled and cleaned of all weeds, the seed is broadcasted, generally at the rate of 1 to 1½ seers per Bengal bigha, i.e., 3 to 4½ seers per acre, though in some districts the quantity used varies from 2 to 4 seers per bigha. *Experiments are being conducted by our Agricultural Department to compare the effects of sowing seed thinly and thickly, but no conclusions have been yet arrived at, as to which system gives better results.* It is a good plan to mix a little dry earth with the seed at the time of broadcasting. The field should be gone over cross-wise by the sower, i.e., once from north to south and a second time from east to west. This ensures a more or less uniform distribution of the seed, a point of much importance in the cultivation of the jute crop. The harrow should invariably follow the sowing in order to cover the seed properly. *Drilling the seed with a drill in furrows 9 inches apart* has been recommended as better than the system of broadcasting, as hoeing is rendered easier afterwards. This system may also be tried.

(j) *After-treatment.*—In many parts of Bengal, no operation intervenes between the sowing and the weeding, but it is a good plan to loosen the earth with a rake about 15 days after the sowing, when the plants have established themselves in the soil. This is especially necessary on clayey lands, where rain and sunshine tend to cake the surface. *Thorough eradication of weeds is essential in the cultivation of jute.* This operation should be begun as soon as the plants are able to stand it, i.e., when they are about 6 inches to 9 inches high. The number of weedings

required varies with local conditions. Two to four weedings should, as a rule, suffice.

The next operation is that of thinning the crop. *The regulation of the distance between the plants has an important bearing on the outturn.* When the plants are too thickly crowded, they grow up weak: and when too far apart they throw out a large number of branches, and proportionally lose in height. From the spacing experiments which have been made at Burdwan, where the plants are thinned to keeping them apart at distances of 4", 6", and 10", it has been found that the 4" thinning has given the highest yield of fibre of the best quality. Sowing in lines 4" apart has yielded nearly twice as much as where sown in lines 10" apart.

(k) *Harvesting.*—The crop occupies the ground for a period of about four months. The time for harvesting depends on the date of sowing, and extends from the end of June to the beginning of October. The exact stage of growth, at which the plants should be cut, cannot yet be laid down definitely, as the subject is still under enquiry. If the fruit of the plant is allowed to get too ripe, the subsequent process of retting the plants for fibre is retarded and the fibre becomes coarse and rough, though it does not suffer in outturn or strength. If, on the other hand, the crop is cut too early, the fibre, though glossy, becomes weak, and the outturn is somewhat reduced. *On the whole, opinion is in favour of harvesting when the fruit begins to form.* The plants should be cut with a sickle just a little above the ground. They should be tied in bundles and allowed to lie out thus in the fields for about two days, so that the leaves may wither and fall off. The leaves that remain on the stem should be shaken off before the plants are carried away to be retted, and at the same time the tops should be cut off with the sickle at the points where the plants bifurcate. The bundles should next be stacked preparatory to steeping.

(l) *Retting.*—After the bundles have been stacked on the fields for two or three days, they should be removed to be steeped (retted) in water, in which they should be allowed to remain till the fibre can be easily separated from the woody portion of the stalks. The immersion of the plants in water induces fermentation, by which the fibrous tissues are softened and loosened. The ordinary cultivator is much handicapped in

this operation. It is very essential for the production of fibre of good colour, *that steeping should be done in clear and sweet water.* The retting is delayed in running water, as the washing effect of the water interferes with due fermentation. A running stream is, therefore, not suitable for retting; but, if possible, the water should not be entirely stagnant. *The best results have been obtained in water that is just moving.* Steeped in muddy or dirty water, the fibre loses its lustre and assumes a greyish colour. Salt water delays the process.

The ordinary ryot is content with steeping in the nearest pool and using the same pool for successive steepings. This undoubtedly leads to deterioration in the colour of the fibre. It cannot, therefore, be too strongly recommended to him that, wherever practicable, *he should ret his fibre in clean water.*

*The result will repay the extra labour involved.* When steeping, the cultivators generally erect posts on either side of the immersed stems to keep them from floating away, then they place on the bundle the tops of the stems that have been cut off and the dried leaves of the plants, and finally so weight the bundles that they remain submerged. Sods and earth are sometimes used for this purpose: *but this is a bad plan*, as it tends to make the water muddy. *It is preferable to use logs of wood and weeds.* The plants generally take from ten days to a month to ret, the period depending upon the maturity of the plants, the temperature, the condition of the water, and the way in which the stems are immersed. After a week or a fortnight, the bundles should be examined in order to ascertain how far the retting has advanced, and the examination should continue from time to time till it is found that the fibre comes off easily. *Care must be taken that the stems are not allowed to remain too long under water*, as overretting produces a dirty dark colour and also weakens the fibre.

(m) *Separation and Washing of the Fibre.*—The stalks, when ready for the separation of fibre are, in some districts beaten against a platform till the pith sticks within are removed. *This process is not recommended*, as the pith often gets broken and mixed up with the fibre, which itself gets knotted and has to be repicked. *It is a much better plan to strip the fibre by hand.*

The next process is that of washing the fibre. This is generally done by taking handfuls of fibre, swinging them round

the head and dashing them against the water. *The separated fibre should always be washed in clean water.* This is a point often neglected by the cultivator, but it is quite possible for him to carry his separated fibre even to a distance, if necessary, and this he should be induced to do. When the washing is finished, the fibre should be left to dry in the sun for two or three days, after which it may be tied in bundles, when it is practically ready for sale.

(n) *Cost of Cultivation and Outturn.*—The cost of cultivation varies with the condition of the land, with the quantity of manure used and with the rate of labour, etc., but Rs. 35 to Rs. 40 per acre may be taken as a fair average cost. An outturn of 15 maunds may reasonably be expected from this outlay, and this at Rs. 7 per maund would give a return of Rs. 100 per acre. A careful cultivator may, therefore, reasonably calculate upon a net profit of about Rs. 50 per acre from the cultivation of this crop. With good seed and good cultivation, the profit can be raised to Rs. 100 per acre involving an outlay of about 80 per acre.

(o) *Causes of Injury.*—Drought may be regarded as the greatest enemy of the jute crop. Floods and heavy rains just after the seed has been sown, or when the plants are still young and tender, are also detrimental to the crop. There are several insect pests which attack the crop, the worst being a hairy caterpillar, called in the vernacular *shuapaka*, which generally appears in very dry seasons and eats the leaves of the plants. Another common pest is *uttaranga*, a cricket which burrows into the ground and destroys the young plants by cutting the roots. A small black-weevil and a green semi-looping caterpillar are also specific pests of this crop. During drought, jute is also attacked by blight. *Any insect pest or fungoid disease should be reported to the Director of Agriculture, Bengal.*

The following method of drenching the leaves with an insecticide may also be tried, but it is a little expensive:—

Take two gallons of kerosine oil; half a pound of bar soap, and one gallon of boiling water. Dissolve the soap in the boiling water, then add the kerosine oil, *and mix the whole thoroughly.* When completely mixed, 30 to 40 gallons of water may be added to dilute the mixture. This should be enough for about an acre of land. Drench the leaves of the plants by means of a syringe.

The following inexpensive method may also be tried:— Sew together sufficient strips of cloth to make a piece 14 ft. by 16 ft. Bring together the two ends and sew at the sides. This makes a flat bag. Strong cloth tags should then be sewn to the mouth of the bag on either side of the side seams and one foot from the seams. Bamboos, 2 feet long should then be fixed between the two pairs of tags 2 feet apart at each end of the bag, and the bag is then quite ready for use. On dry lands, the bag can be held by two men on either side and drawn over the plants (at an even height) to trap the caterpillars, which should then be destroyed by plunging them into kerosine oil and water (one part of kerosine oil to ten parts of water.) The bag must be rapidly drawn over the crop.

(p) *Fraudulent Adulteration.*—Cultivators, sellers and purchasers of jute are earnestly exhorted in their own interests, to refrain from adulterating their jute with sand and water. This practice has led to a most unwarrantable deterioration of the fibre in recent years; and merchants are loud in their complaints regarding the quality of the fibre now being put into the market. In September 1901, the Calcutta Baled Jute Association addressed the Director of Agriculture, Bengal on the subject of the deterioration of the quality of the fibre. This was followed in January 1902 by a communication to the same effect from the Dundee Jute Inspectors' Association to the Secretary of State for India. As a result, field experiments were started at the Burdwan Experiment Station in 1902, by the Bengal Agricultural Department under the guidance of the Inspector-General of Agriculture, India. These experiments continue, and have up to this disclosed very instructive results some of which have been referred to in preceding paragraphs, but still there exists fraudulent adulteration which impedes the efforts of the Agricultural Department in the matter of improvement of the fibre—repressive legislation may be sought for, but unless the gravity of the situation is taken in by growers, sellers and purchasers, the quality of the fibre will stand where it is at present and in fact will become worse day by day and year by year. Soon after the commencement of field enquiry into the causes which tend to deterioration of the crop, it was recognized by Government, that it was necessary to supplement and amplify field work by laboratory experiments. This

work, dealing more with the chemical and biological side of question was entrusted to an expert officer in the person of Mr. R. S. Finlow, B. Sc., F.Cs.—Mr. Finlow has given much thought and care to his Laboratory investigations and his work has come of much use to the Bengal Agricultural Department in framing a scheme of experimental trials with this crop.

As an outcome of all the activity displayed by the Agricultural Department as regards jute, it has been possible to enlist the co-operation of the Baled Jute Association whose representatives are annually appraising samples of jute grown at all experimental stations of this Province.

(q) *Commercial divisions, races, and markets.*—The commercial divisions of jute tracts and the chief races of jute are:—

<i>Commercial divisions of the jute tract.</i>	<i>Chief races of jute.</i>
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1. Uttariya or Northern	... {	<i>Heuti</i> (late) of Rangpur and Jalpaiguri.
2. Serajganj or left bank (really right bank of the Brahmaputra.)	{	<i>Bhadiya</i> (early) of Rangpur and Jalpaiguri.
3. Narayanganji or right bank (really left bank of the river.)	{	<i>Kakaya Bombai</i> of Serajganj- <i>Deshi.</i> of "
4. Deora or char land	... {	<i>Boran</i> or <i>Barapat</i> of My- mensingh.
5. Deshi, i.e., grown near Calcutta.	{	<i>Sutpat</i> of Faridpur. <i>Deshi nalpath</i> of Hooghly.

The *principal* markets for the sale of the fibre are Serajganj (Pabna), Narayanganj (Dacca), Madaripur (Faridpur), Chandpur (Tippera), Domar (Rangpur district, and Chitpur (near Calcutta).

(r) *Uses of the Jute Plant.*—The jute plant is utilized in this country for many different purposes, besides being permanently used for the manufacture of its fibre. It is supposed to be a very good antidote to a noxious weed *bhadulia* which is very destructive to the rice crop, and *ryts* often grow jute to eradicate this weed.

The leaves and tops of jute plants are a favourite potherb in the season, of every Bengali kitchen. The leaves also occupy an important place in Indian Pharmacopœia. As a green manure crop, jute holds its own against other crops. The stems are used for fuel and for fencing, especially in betel leaf gardens. Jute also supplies sticks for country-made matches. The roots

of the crop are valuable in the manufacture of paper. Oil for burning purposes can be extracted from it. Its cake also makes a useful, though perhaps not a very nutritious, food for live stock.

As a fibre, it is used for the manufacture of cordage, cloth and paper which, under different conditions and circumstances, assume very different names. As cordage, the manufacture ranges from the thinnest twist to the thickest ropes for hawsers, and gunny cloths of different thicknesses are largely made. The coarsest kind which is very loosely woven is commonly used for sails for country boats.

(s) *Jute growing classes.*—For the information of those who do not belong to this Province, it may be mentioned that the cultivation of jute in Bengal is not confined to any particular class or caste of the rural population. All classes are engaged in it, irrespective of caste, whether they be Hindus or Mohamedans.

(t) *Concluding remarks.*—In conclusion, it may be mentioned here that two very careful forecasts of the estimated acreage and outturn of this crop are published every year by our Agricultural Department for the benefit of the mercantile community and of the public in general. And, it is hoped, that with all the attention given to its cultivation by Government, there will be an expansion in its area and a development in the industry which has before it a future so commercially brilliant.



## COTTON CULTIVATION IN BENGAL.

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THE cotton area in Bengal is steadily contracting. It used to be fairly common within the memory of men still living. But it has completely vanished from many districts within a few decades. But, taking India as a whole, the area under the crop is expanding. The following table may be interesting:—  
Acreage under Cotton.

Years.	In Bengal and Eastern Bengal.	In all India.
1892-93	229,900	13,422,107
1900-01	127,700	14,231,150
1904-05	89,800	19,014,432

It is doubtful if cotton was ever a favourite crop with the Bengal ryot. Dacca was famous for her wonderful muslin, and the district produced the finest cotton in the world. But the cultivation of this cotton does not appear to have been a matter of much profit to the ryot. John Bebb, Commercial Resident at Dacca under the East India Co., writing in 1790 gave the cost of cultivating an acre of *Photee* cotton as Rs. 28-8. A fair average crop was 9 mds. of seed cotton worth only Rs. 36. This, therefore, left the ryot no more than Rs. 7-8 per acre as profit. Indeed, according to Mr. Bebb, the actual cultivators of this cotton "were ground down until a bare subsistence was left them."

Though cotton used to be fairly common only a short time ago, it is doubtful if Bengal ever grew sufficient cotton for her own requirements. There is evidence that, about the middle of the 18th century, when her manufactures were still in full activity, if not in the height of their prosperity, Bengal grew only one-eighth of the cotton she required, the quantity imported from other Provinces of India amounting to seven-eighths of the total consumption (*vide* Medlicott's *Cotton Handbook for Bengal*, p. 44). Cotton cultivation was carried on in Bengal for local purposes only. It seldom appeared for sale

even in the village bazaars. It was spun by the village women and served to clothe the ryots and their families after being worked up by the nearest weaver.

The reason why Bengal does not grow much cotton lies on the surface. It is because the soil and climate are suitable for more remunerative crops. The famous Photee of Dacca, as we have seen, yielded on an average 9 mds. of seed cotton per acre. Taking one-fourth of this as lint, the fibre amounted to 180 lbs. This is a very high outturn, for, taking India as a whole, the average yield of cotton per acre does not much exceed a maund. Photee, though exceedingly fine, was probably a short stapled variety and we can only speculate as to what its price would have been if it still continued in existence. But, taking such cottons as we now find in general cultivation in Behar or Choto-Nagpur, and taking the outturn even as 200 lbs. per acre, if cultivated in the fertile alluvial soil of Bengal, the gross value per acre would not be much above Rs. 45. Now, compare this with jute. An acre would yield on an average 15 mds. of fibre which, even at Rs. 8 per md., would mean Rs. 120. In the present year of high prices of food grains, the ryot has reason to be particularly grateful to jute. For my part, I cannot see any sense in advising the ryot to take to cotton in place of jute.

There are millions of women, Hindus and Mahomedans, who are debarred by social etiquette and the exigencies of domestic life from working outside their own homes. You want to find employment for their idle hours. They can spin as their grandmothers used to do, not so very long ago when the *chakra* was a great feature of every village home. You are ready again to welcome with joy the rough *saries* and *dhuties* of home spun yarn. There is no competition of wages here. There are hundreds of thousands of poor widows who would only be too glad to add something, however small, to their present impossible incomes. Against this idea so enthusiastically put forth by many of our countrymen to-day, I have not a word to say. I only contend that it is not necessary for our ryots to grow cotton in place of a more remunerative crop. We can buy the fibre that we want our wives and daughters to spin. There is no lack of cotton in India. Vast quantities are exported to foreign countries, to distant Japan and Germany

for instance. We can import it from the other Provinces as we used to do before.

I could understand the present excitement over cotton cultivation if the idea was to grow a better crop than is found in the country generally with the object of regaining our lost markets. Consider for a moment our position in this respect. In the later eighties Great Britain took between 30 to 40 per cent. of the cotton exported from India. In 1899-1900 the amount had fallen as low as three per cent. And though there has been a slight improvement since (in 1903-04 the amount was 6 per cent.) yet, practically speaking, Great Britain has closed her door against Indian cotton.

Of the world's commercial demand for the raw material, the United States alone supply as much as 85 per cent. She produces on an average 10 million bales (bale = 500 lbs.) per year, and can increase her supply practically indefinitely if the demand were to grow and the present prices maintained.

Compare with this the outturn of cotton in India. In 1904-05 the mill consumption and exports amounted to 3,390,000 bales. Adding 380 thousand bales, the official estimate of consumption outside the mills, the total comes to 3,770,000 bales. Our bales are 400 lbs. each. Reduced in terms of 300 lbs. bales for comparison with the United States figures, our annual output amounts to barely 3 million bales.

India has at present about 19 million acres under cotton against 28 million acres in the United States. Yet, while the latter produce ten millions bales of cotton per year, we produce only 3 million bales. Or, in other words, while the United States acreage exceeds ours by barely 50 per cent., her annual outturn exceeds ours by something like 250 per cent. The average yield of an acre in India is about a maund of 80 lbs.; that in the United States is 200 lbs. What is more, American cotton is of superior quality and fetches a much higher price in the market.

As for Egyptian cotton, there is no comparison between it and either American or Indian cotton. The outturn is about 500 lbs. per acre, and the price per pound is quite double that of American cotton. Egyptian cotton rather competes with the Sea Island cotton, the finest cotton in the world, of which Georgia, Florida and South Carolina produce only a few thousand bales every year.

Now can we grow American cotton in Bengal? Can we grow Egyptian or Sea Island cotton? Can we improve the quality and yield of our indigenous cotton by breeding and selection? Can we by suitable manuring so increase the outturn and profits of cotton cultivation as to make it worth the attention of our ryots, if not in the Eastern districts, at any rate, in Choto-Nagpur and the adjoining districts?

The attempt to improve Indian cotton is not new. It has occupied the attention of the Government of India for nearly three quarters of a century.

It began in 1829\* by the Court of Directors drawing the attention of the Government to the importance of the indigenous short-stapled varieties and recommending for trial throughout India the cultivation of the finest of Dacca cottons.

In consequence of this order, Dacca cotton was experimentally planted in many places throughout Bengal, without success however.

Government spared neither money nor trouble. Large farms, each consisting of several hundred acres, were established under European supervision, and, later on, practical and experienced cotton cultivators were brought over from the United States. Sea Island, Egyptian, Upland Georgian, New Orleans, Bourbon, Peruvian and other varieties were tried but all to very little purpose.

Neither time nor space would admit of my referring even cursorily to the various attempts. I would only refer the student who is interested in the subject to Mr. Medlicott's *Cotton Handbook for Bengal*, which was published in accordance with the resolution of His Excellency the Governor-General in Council, dated 22nd July, 1861.

The book is a digest of all information available from official records and other sources on the subject of the production of cotton in the Bengal Provinces. By the term Bengal Provinces, however, was meant not only what now constitute Bengal Proper and Eastern Bengal and Assam, but also the United Provinces and a part of the Punjab on the one hand, and Arracan, Pegu, Tenasserim, Singapur and the Andaman Islands on the other.

I shall content myself with a few words on the work of one of the four American cotton planters who landed in India

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\* An earlier attempt was probably that made in 1826 to grow Sea Island cotton in Balasore. This proved an utter failure.

in January 1841. I mean Mr. Price Mercer. He was stationed like his fellow planters in the North West; but, later on, *at his own request*, he was transferred to Dacca, which had been from time immemorial the best cotton-field of Bengal. Mr. Price was, according to the Governor-General, a person "thoroughly acquainted with the plantations in America, and conversant with all circumstances connected with the production of cotton of the best description."

Mr. Price was, like his brother-planters, given a free hand, and readily supplied with all that he suggested as necessary for carrying on his experiments.

The course of these experiments, which lasted from 1844 to 1849, was attended by a series of disasters. The experiments were a failure in every sense. They not only failed in proving to the native cultivators that fine kinds of exotic cotton could be profitably grown in the district, but they failed in turning out any cotton whatever, at any cost of production, of the quality approved by the English brokers, and worse still, they failed to establish any fact as to what varieties of seed were suited, to any of the different localities tried. At the close of the experiment, Mr. Commissioner Dunbar, who was throughout its career greatly interested in its success, informs Government that its history does not establish any one fact of general interest, certainly not that the Dacca district is incapable of growing exotic cotton. According to Dr. Royle, the failure was due to the American planters sticking to their pre-conceived notions and failing to adapt their methods to the soils and, especially, the climates of India.

At his own request, Mr. Price was allowed to transfer the scene of his activity from Eastern Bengal to Assam, where his failure was only worse; but we shall not follow him there.

In America cotton is grown in the south. It is sown in April and the harvest is finished by November. The average rainfall during the growing period of the plant, (from April to September), is about 25 inches. In the early months (April and May), the precipitation is on an average about 3.5 inches a month. The rainfall, as everywhere else, varies, of course, from year to year, but in the Southern States of America it varies within very narrow limits, and the cotton crop never suffers to the extent of being "half a crop." The crop suffers if the rain-

fall in April and May exceeds the normal even by an inch per month.

Now compare our conditions with those of America. In Chota Nagpur, Behar and Orissa there is practically no rain before June to admit of ploughing or sowing. But then, when the monsoon begins, the downpour is tremendous often amounting to 10 or 15 inches of rain in a month.

However, where the soil is undulating, the rain does not stand on the ground, and this heavy precipitation does less damage to the cotton crop than in the level country. In East Bengal, on the other hand, we have moderate rain in April and even in March. This is very favourable, but, unfortunately, when the monsoon does break, the rainfall is even worse than in Behar. In many of the Eastern districts, the rainfall from April to September amounts to 70 or 80 inches and even more. Add to this the general low level of the Eastern districts—a condition which is also unsuitable to cotton. American cotton, as we have seen, is only a moderately moisture-loving plant.

If our conditions are unlike those of the cotton States of America, they are still more different from the conditions of Egypt. In that country there is practically no rain, all cultivation depending upon either irrigation or inundation. The following table gives the average annual rainfall at a few of the important stations:—

	Annual rainfall.
Alexandria ... ..	8.1 inches.
Port-said ... ..	3.4 do.
Ismalia ... ..	2.1 do.
Suez ... ..	1.1 do.

The rainfall at Cairo is very uncertain. In many years the fall does not even amount to an inch.

Cotton is grown only in the Delta of the Nile. This industry to which Egypt owes her present financial prosperity is hardly three quarters of a century old. The country used to be inundated by the Nile making it impossible for any crops to be grown during the season of flood. But Mahomet Ali Pasha put up vast embankments to keep the flood water out. He also dug canals to provide for irrigation. Formerly cotton was cultivated to a very small extent as a perennial only in the enclosures of Upper Egypt. Now cotton is grown every where in the Delta as an annual crop. As in America the sowing takes place in April

and the harvesting is finished by November. The crop altogether receives about 14 irrigations, of which 9 are given by lifting water from the bed of the river. Almost as in Eastern Bengal the river begins to rise from early in June, and by August rises sufficiently high to admit the water through openings in the dykes.

But irrigation, though it certainly means expense, also means regulating the moisture conditions perfectly. There is, on the other hand, no controlling rainfall. In America there is no irrigation for cotton, but there the rainfall is moderate and fairly regular. With us the rainfall is immoderately heavy. The out-turn of Egyptian cotton is on an average 500 lbs. per acre; of American cotton 200 lbs.; while of Indian cotton it is no more than 80 lbs. American cotton is superior to ours in quality, while Egyptian cotton is so superior to both that there is practically no comparison between them. Egyptian cotton competes with Sea Island cotton of which America grows only a few thousand bales and of which the price varies between two to three times that of ordinary Upland or New Orleans cotton.

But Sea Island cotton does not grow very well in Egypt nor has America succeeded with Egyptian cotton. Because, Dacca used once to grow very good cotton, therefore, it does not necessarily follow that she will be successful with American, Egyptian or Sea Island cotton.

Interspersed through the records of failure are instances of success, but very curiously these apparent victories were not followed up. Considering, however, the general fate of the efforts, one may seem too bold to recommend their renewal; but the science of agriculture has advanced a very great deal since the days the American planters worked and failed. When their rule of thumb did not avail them they were left completely helpless. But it ought not to be impossible now by selection and breeding to produce a plant to suit our conditions. We may take courage by the example of America herself in overcoming the difficulty with the acclimatization of Sea Island cotton, the finest cotton in the world. The story is interesting. This cotton (*Gossypium barbadense*) is a native of the West Indies. It is a perennial or tree variety yielding in its native home its harvest in the winter. When an attempt was made to cultivate it in the mainland where the winter is much severer than in the Island, the plants were

killed by frost before bearing any flowers or pods. The stocks were, however, allowed to stand over and next spring some of them threw up new shoots. These bore some flowers and ripened some pods by next autumn before being again taken over by frost. The few seeds thus secured formed the starting point in the work of acclimatization. These seeds were sown, and from the plants that came up, those giving the earliest flowers and pods were selected as mother-plants. This simple process was repeated for a few years till a race was obtained yielding its harvest by October and November like the general Upland cotton.

Not only has Sea Island cotton been acclimatized in the United States, but what is more, it has been so improved by careful selection as to be double the value of the original variety.

I have not space to go into the attempts that are being made in various countries, but specially America, to improve their native varieties of cotton by crossing with foreign varieties such as Egyptian and Peruvian. Not only are breeding and selection better understood now than before but also in manuring we have advanced a long way from the time when the chemical experts of the Government of India recommended a peaty soil for the finest sorts of cotton on the express ground that the plant took the carbon required for its lint from the ground. A tyro now knows that neither cotton nor any plant in the world ever takes any carbon from the ground; they take it, of course, from the carbonic acid of the atmosphere. That cotton required phosphoric acid for its best development had not yet been discovered, nor had the name of super-phosphate been heard of. But I imply no blame to those experts personally who lived before the days of Liebig, Laws, and Gilbert. They merely laboured under the limitations of the infancy of science. But the fact remains that the ideas of 60 years ago have been revolutionized.

We may, therefore, refuse to accept as final the failure of the forties. In our light, loamy soils, specially in the high lands, we possess a better equipment for the finer grades of cotton than the stiff clay commonly known as the black cotton soil of Central and Western India. Again in the fine weather we enjoy from October when the bells open and the cotton is picked we enjoy the *sine qua non* of cotton cultivation in the matter of weather. The unfavourable features of the climate previously mentioned, though serious, do not seem to be insurmountable.



## DHARMA GOLA.

**RAI PARVATISANKARA CHAUDHURI,**

*Vice-President and the Late Honorary Secretary to the  
Indian Industrial Association.*

It is an established fact that famines are of more frequent occurrence in India than in any other part of the world. Year after year we hear of some part or other of this country being affected by famine or scarcity: We also know how disastrous are the results thereof; thousands die of starvation, want and disease, notwithstanding the efforts of Government and of private persons to save life.\*

It is a well-known fact that famines in India are seldom caused by general scarcity all round or by prohibitive high prices. While one part of the country is affected by famine there may be good crops in some other part. But the Indian peasants are generally found wanting in reserve-stock, both of money and of grain, to fall back upon in a bad year.

Their average income is so low that it is not possible for them, even in the most prosperous years, to lay by individually enough either in money or in grain to last them throughout a bad season.†

But what may not be achieved by individual efforts can be done with the aid of village communities. I have found that, by inducing such communities to keep a common stock of grain in a good year, and by profitably investing the same in comparatively bad years, a reserve might be built up in each village which would enable the villagers to keep them going during a period of scarcity, and also to avoid a calamity through any sudden fai-

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\* The late Mr. Digby, C. I. E., estimates the total death from famine mortality during British period from 1769 to 1901 at 30,625,000.

† According to calculations made in 1901 by the Government of India the average income per head of population in India was found to be, £ 2 or Rs. 30 per year. But the late Mr. Digby puts the figure at Rs. 18-12-6 per year.

lure in crops. It has been my experience that there is a number of poor people in villages who even in good years are invariably in want of food grains for two or three months preceding the harvest time. They tide over the difficulty by resorting to the Mahajan (money-lender) or taking advances on their crops from the trades people.

I have been intimately connected in various ways with the work of affording relief to tenants in our zemindary in the districts of Dacca and Dinajpur during several periods of scarcity in those districts. I have had opportunities of observing on a small scale how gratuitous relief is given, advances of money are made, cooked food provided to the famished people, and wages paid to able-bodied persons employed in relief work. I have also watched the advantages and disadvantages of these methods of relief.

The scheme of corn-banks explained below is the outcome of such experiences. The scheme being in the nature of a mutual assurance, the people will be in a position to resort to these banks more readily for timely relief than to any institutions which can be provided for them by Government or private charity, or by the Mahajans (money-lenders) working for their private gain. These banks, it is hoped, will not only help the poor people when famine actually stalks through the village, but will serve as permanent grain stores from which at any time throughout the years any poor villager can have his immediate want supplied without any difficulty.

To these grain banks I have for several reasons given the name Dharma Gola.\* They should be started in the village during a year of plenty, and by judicious organization it would be easy enough for a zemindar or a tenant, who enjoys the confidence of the village people, to establish these banks.

My first experiment was made thirteen years ago at Jayaganj, in the district of Dinajpur. The scheme was explained

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\* The name which was first proposed and was a most appropriate one was Lakshmi Gola. But as Lakshmi is also the name of the Hindu goddess of wealth in general, the name might be objected to by people other than Hindus, so I changed the name to Dharma Gola. This would convey an idea of usefulness and of sacredness demanding respect and veneration. The word Dharma is a general term and would be unobjectionable to persons of every denomination.

to the tenants of the village, and they were requested to establish a Dharma Gola by making a rateable contribution of ten seers of paddy, or its equivalent in money, per bigha, for a stock to start the bank with. As they had a bumper crop that year, I thought that the request to make a modest contribution for such a purpose would be acceded to.

The principal men of the village assembled at a meeting, and the majority of them decided to establish a Dharma Gola on the lines suggested. It should, however, be mentioned that there were some dissentients who doubted the ultimate success of the experiment, Panchayats were nominated at the meeting, and they drew up a list of contributions freely promised. They went on with the work, but finding the collection of paddy a little irksome, they collected Rs. 105-5-9 from the villagers and purchased 80 maunds of paddy, and stored it in an ordinary gola erected by me for the purpose. The paddy was purchased in the month of Chaitra, 1299, Bengali era, corresponding to April, 1892. It should be noted that all the villagers did not contribute to the full extent of the rate fixed, but as it was an experimental measure, particular care was taken through the Panchayats not to press anyone to contribute against his will.

The Dharma Gola being thus established, loans of paddy began to be asked for and were given by the Goladar Panchayat. The stock increased from year to year from interest on loan. The institution also gradually advanced in public estimation, as persons in increased numbers began to be benefited every year.

The quantity of paddy stored to begin with at the Jagagunj Dharma Gola was nearly 80 maunds, and this stock has increased in 8 years to 1,360 maunds. The last stock was taken on the 31st of Chaitra, 1311, Bengali era corresponding to 15th April 1905. After another eight years it may be possible to form a permanent reserve-stock of 1,500 maunds of paddy to meet any serious non-realisation of loans in case of failure of crops in the village. That quantity, I reckon, would keep 900 persons of the village fairly provided with food for the two months and-a-half of the sowing season.

Besides the Dharma Gola at Jagagunj, I established one at Shaitgarh Teota and the other at Rahatpore in the district of Dacca in March 1900, when there was a good harvest after a

bad year. Only a small portion of the villagers in these two instances came forward with earnestness and paid their contribution in grain. The stock stored in these two Dharma Golas was small, but in the case of Shaitgarh Teota Gola those who did not contribute in the first year, contributed in the third year, as they were convinced of the usefulness of the institution by its working in 1901 and 1902. The original stock of 50 maunds has now increased to 182 maunds in 6 years. In the case of Rahatpore Dharma Gola, the original stock of 60½ maunds has increased to 186 maunds. The banks were entirely managed by the village Panchayats without any outside help. The result is being keenly watched by the neighbouring villagers who intend to start several such golas as soon as they would gather a good harvest.

Notwithstanding the difficulties of introducing a new scheme amongst the illiterate and conservative peasantry, the scheme has been practically tested and found to be successful in the above cases. The working of the scheme being very simple and in accordance with the instincts of the people, it is at once grasped by them when properly explained. It also lies within the scope and the slender means of the village communities. The scheme is, therefore, bound to be successful throughout Bengal under proper safeguards.

It, however, remains to be seen whether the institution can be introduced with equal success in other parts of India where rice does not form the staple food of the people. For this purpose it would be necessary to institute enquiries into the nature of the grains which form the staple food in different localities, and for how many years each of those grains retains its quality as food without deterioration, and whether it improves or deteriorates in its quality as food-stuff in the 2nd, 3rd and 4th years. So far as I have been able to gather information during my travels, I have found that in the Madras and Bombay Presidencies, in Central India and some parts of the North-West Provinces *bajra* forms the staple food crop of the peasantry in several large areas, and *bajra*, like paddy, remains in good condition for at least five years. In these localities *Dharma Golas* can be very successfully established with *bajra* as capital. In some parts of the Madras Presidency, in Orissa and Bengal and Assam, rice being

the stable food no difficulty can arise in establishing *Dharma Golas* with paddy. If any means can be discovered by which wheat can be preserved in wholesome condition for three or four years, there is not the least doubt that the whole of India can have the benefit of the scheme. There would thus, after a reasonable time, accumulate a stock of grain in every village of India, and when there is scarcity of food or famine, relief will be ready, cheap, efficient, and handy, without the expenditure of a pice from the public exchequer or any appreciable trouble or cost to the villagers; and a poor father or mother shall have no occasion to shed tears at the sight of his or her hungry children crying for food. The terrible loss of life during famines will be thus prevented, and the Government will, at least, in a great measure, be relieved of the gigantic task of feeding the people at an enormous cost. The institution, in addition to these advantages, will serve as a beneficial lesson to the villagers in teaching them co-operation, self-help and thrift of which they stand in so much need.

The special advantages of such banks may be summed up as follows:—

1. A Dharma Gola can be established in each village from its own resources.
2. The contribution of each individual, being only a small portion of the annual yield of paddy, is not likely to cause any hardship.
3. The cost of its upkeep will not be heavy, as the posts of the Panchayats other than the Goladar will be honorary. Fit men for the management of the banks will be always available in the village.
4. There will be no scope for excessive borrowing from such banks, as there may be in the case of money banks.
5. On the accumulation of a stock of paddy in the Dharma Gola, old paddy will be exchanged for new paddy securing a profit and preventing sickness that is caused from the consumption of new rice.
6. The Dharma Golas, by supplying grain for food to the cultivators in want, would allow them to appropriate better prices for their crop.
7. The Dharma Gola being the public property of the village, and no one having any right to sell the stocks, a reserve stock of grain will ever remain in the country.

8. The Dharma Golas, if established all over the country, will not only benefit the agricultural classes, but also the Zemindars and the Government, as it will relieve them of the necessity of making contributions for assisting the people during famine and scarcity.

9. The initiative being taken by the villagers, and the Panchayats being appointed by them, they will take a special interest in these Dharma Golas, and will try by all means to maintain them on an efficient basis.

10. During scarcities of food, a formidable difficulty presents itself in the transport of grain to villages which are without railway or steamer communication. The establishment of these banks will solve the difficulty.

I may state also that the scheme has been favourably spoken of not only by the entire Indian press of Calcutta, but the English papers of Calcutta also consider it to be a very handy and simple solution of the famine question in India. Mr. W. Gourlay, I.C.S., the Registrar of Co-operative Credit Societies of Bengal, lately visited these institutions and passed very favourable remarks upon them. It would not, I trust, be out of place to mention here that on a representation being made by the Committee of the Indian Industrial Association the Bill to provide for the constitution and control of Co-operative Credit Societies was materially changed and made elastic by the select Committee in charge of the Bill so as to include *Dharma Golas* which, it is expected, will be established in many places in India in future.

If the scheme recommends itself to the Government and to the agricultural classes in general, and if the District Magistrates, Sub-Divisional Officers, and Tahsildars in their tours, explain the rules and urge on the villagers to establish Dharma Golas, and if the owners of estates put forth their endeavours, there is every probability of Dharma Golas being established throughout the length and breadth of the country. To give an additional impetus, Government might create some distinctive title to confer on those villagers who would initiate the establishment of these Golas and on the Panchayats who by judicious management would make them successful.

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RESOLUTIONS OF  
**THE INDUSTRIAL CONFERENCE**

That this Conference re-affirms the Resolutions 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 the whole of India, and that a Committee, consisting of Mr. A. C. Sen, Mr. P. N. Bose, Lala Lajpat Rai, Mr. G. V. Joshi, Mr. D. E. Wacha, Mr. G. Subramania Iyer, the Hon'ble Mr. Vithaldas D. Thackersey, Mr. Sarvadhikari, Mr. R. C. Dutt, and the General Secretary be appointed to prepare a memorial on the above lines for submission to Government by the President and the General Secretary.

That this Conference conveys its thanks to the Government of India for appointing a Committee for making recommendations for the use by Government Departments of indigenous articles in preference to foreign goods, and requests that they be pleased to direct the early publication of the report of the Committee, so that the public and traders in India may have an opportunity of considering it before final orders are passed on the subjects.

In view of the importance of having an industrial survey of India made by Government and having regard to the recommendation made by the Committee on industrial education to that effect, this Conference requests Government to institute such a survey and empowers the President and the General Secretary to submit a memorial on the subject.

That this Conference specially invites the attention of the public to the great importance of introducing the use of improved hand-loom among the weavers of India, of promoting technical education by the establishment of schools and classes, and of starting laboratories for the purpose of determining the industrial value of Indian products.

The Conference next adopted a Resolution to ask the Provincial Committees already established to take steps to promote the industries in their several Provinces, to compile useful facts and suggestions for submission to the next Industrial Conference, and to raise suitable funds for carrying on their work.

That this Conference re-appoints Rao Bahadur R. N. Mudholkar as General Secretary and Mr. C. Y. Chintamani as Assistant Secretary and empowers the President and the General Secretary to appoint an additional Assistant Secretary and an establishment on suitable pay, so that the Assistant Secretary may be free to visit the different Provinces and help the Provincial Committees in all matters in which they may require assistance, and this Conference allots a sum of Rs. 10,000 for meeting the expenses for the next twelve months and also for issuing a quarterly bulletin of industrial information under suitable management."

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