

THE
ECONOMIC EFFECTS OF WAR
ON
INDIA.
PART 1.
Indian Industrial Development
During the War.

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To
MY COLLEGE.
THE CANNING COLLEGE LUCKNOW,
where
I GOT THE OPPORTUNITY
of
Studying & Teaching
Economics.

PREFACE.

It was in December last that I was asked by the Secretary, Student's Society Lucknow, to contribute a paper in connection with celebrations of Peace. The subject I chose for this paper was "Indian Industrial Development during *during* the War". The special study which I made in the preparation of the paper unfolded before my eyes a state of affairs which 'the man in the street' was obviously quite ignorant of, but to know which was clearly of capital importance. All this could not be condensed in a little over an hour's paper. Hence the present work.

In March 1919 the Indian Munitions Board issued a revised edition of the Industrial Handbook, a volume of over 400 pages, written by experts and giving in full detail all that had been done during the last one year and a half of the War to develop Industrial resources. I have freely drawn upon this excellent work as well as utilised all other available resources in Government reports, newspapers and magazines.

This work ought to have been ready by April at the latest, but the scarcity of paper upset the arrangements.

Inspite of careful proof-reading mistakes have crept in, some of *wrong forms* which it was not easy for a novice in proof-reading like me to distinguish from one another, specially when for want of good paper proofs had sometime to be given on thin brown paper,—for these I crave the indulgence of the reader, and some of matter in respect to which a list of errata has been appended.

Lucknow, }
August 1920. }

IKEAL BAHADUR SAKSENA.

INTRODUCTION.

There is no doubt that the war which has just had such a magnificent ending for the Allied cause was an unprecedented war, involving on an unprecedented scale destruction and deterioration of men, money and materials and it will take years before the loss of lace of valuable lives is made up, before the burden involved by a crushing debt of £ 50,000 millions—interest alone on which, at a rate of 5 per cent, amounts to £ 2,500 millions—equivalent to 25 times the total gross revenues of the Government of India—is relieved and before the wastage of the world's wealth is restored.

But this war, like every other evil in God's Creation has not been an unmixed evil.

This war has taught us all a new lesson of self-sacrifice and co-operation for the common good, has quickened human conscience and sympathies and brought about an up-heaval in men's ideas, their status, and their relations with each other, never before seen in the world. This war has given us experience and wisdom of centuries condensed in months and minutes and united in a common bond all human beings differences of race, colour and creed notwithstanding. This war has demonstrated to the world-dominators to the hilt and to all others besides the underlying virtue and justice of the golden principles of 'give and take' and 'live and let live'. This war has sent a thrill of new life throughout the world and awakened to a new sense and consciousness of rights and duties backward nations. This war has served to curb the ambitions of Imperialists and Militarists and given a new lease of hope to the downtrodden and the depressed. In short, this war threw into the melting-pot the destinies of the human race and out of it is emerging a new and rejuvenated race, bent upon living in peace for all times to come.

To India also, the evils of the war have brought in their train nothing but good. It is not so much the good as the prospect of good which is bound to come as years roll on.

It will be my humble part to take up the Economic side of this 'good' and show by facts and figures that that chapter of our destiny which confined us to be "hewers of wood and drawers of water" has been finally, definitely and irrevocably closed, while the era in which we shall be called upon to play an ever-important part, befitting our ancient civilisation, culture and ideals (spiritual); has already dawned by the inclusion of India as an original member of the League of Nations and as a signatory to the Covenant securing the peace of the world and is further to grow into a bright sunshine by the introduction of Reforms, announced on the memorable 20th of August 1917, just passed by the Mother of Parliaments.

The following pages have been written with a threefold object—*firstly* to give an account of the condition of industries in general before the war, *secondly* to give an account of what has been done to develop India's resources for War purposes and so to bring about general industrial development and *thirdly* to indicate possibilities and prospects of future development of industries.

They thus put together in a concise form the Industrial Development of India during the War or the Industrial side of Economic Effects of War. To complete the survey of Economic Effects of War on India two more sides remain to be dealt with, *viz.*,

- (1) Commercial and
- (2) Financial,

and these I hope to do in recent future, if the present work meets with recognition at the hands of those who want to know what Economic Effects the world-war has produced in India and how these are likely to affect the future of the country which we all have learnt to love so well.

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INDIAN INDUSTRIAL DEVELOPMENT.

Section 1.

A bit of modern history.

Before dealing with the development of Industries in India during the War, I believe it will contribute to a better understanding of the present situation if I give here a bit of modern history in connection with the advent of modern Industrialism and its progress in India.

India an agricultural country, not always so—We all know that India is a vast country predominantly agricultural. But it was not always so. Before the Era of Iron and Steam India was both an agricultural and a manufacturing country.* She was supreme in both. But machines turned the table upon her. Though she has been worsted in competition, full, free and unfettered, she has remarkably succeeded in remaining the only manufacturing country in the original sense of the term,—manufacturing, *i. e.*, manipulating by the labour of hand, *human* hand, some of the vast resources Nature has endowed her with—while other countries began to turn to iron and steel hands, worked with the help of steam, gas or electricity.

The Industrial Revolution in Europe, India unaffected by it—The Industrial Revolution in Europe, which changed the whole aspect of Industry in Europe, began in England so far back as 1760. The outposts of that same Revolution did not reach this country before 1850. So we can safely assert that with the passing of the Government of India

* I have seen it denied that India was ever a great manufacturing country. If it is meant, in the modern sense of the term, of course neither India nor any other country was a great manufacturing country. If, however, we judge India from the prevailing standard of a century ago, we must admit that India was a great manufacturing country both among Eastern and Western countries. She supplied her own wants of all manufactures as well as exported the surplus to other countries, where it was highly prized.

into the hands of the Crown began that change in the methods of work which is transforming slowly but surely the serenity which characterised Indian life into restless activity, competition and bustle which form the prominent features of life in the West.

At first, this transformation began in Port Towns, but by and by it has spread its contagion over the whole land. The Indian, as a whole, did not welcome this change, because it meant and spelt a metamorphosis of the traditional life which he had been leading and loved for centuries. He looked upon it with a hostile eye. Therefore he did not do anything to turn it into a useful weapon, rather he preferred to wait in silence and suffer passively the losses that fell to his lot. He gave up in despair industries after industries and flocked to primitive agriculture. The result of this was that he became more and more dull and obstinately adhered to old notions, customs and methods.

Reconciliation of the Indian to the change—It was only very recently that Indians reconciled themselves to the inevitable changes that the Revolution must bring about in the methods of work. It was then that they began to think out means and measures by which they could harness the forces of the Revolution. They realised that it was essential to have coal and iron (by means of which great Industrial countries have become manufacturing) and other minerals, that they should study modern sciences and take to research work, because it was by means of these and these alone that other nations had brought the Industrial Revolution under their guidance and control.

Factors of Industrial Progress, India not efficient in any.—The modern history of these other nations shows that in the 20th century the Industrial development of every country must depend on the provision of a vast amount of capital, in the form of machines, of labour educated, trained and skilled and of organisers who devote themselves heart and soul to the questions of 'internal' and 'external' economies of the business they undertake. India is not yet effi-

cient in any of these respects, as it ought to be, to make Industrial progress at a rapid pace, like Japan.

Why we have not been able to do much.—We started late and have been left far behind in the race of modern Industrialism. We did not study mining, we did not study metallurgy, we did not study chemical and mechanical sciences and therefore we could not ourselves manufacture, in the modern sense of the term, the raw materials which we continued to export in exchange of finished goods which began to form, and have formed, essentials of our life; and still we have not been successful in the coveted direction of Industrialism to any appreciable extent.

Practical, chemical, mechanical, engineering and metallurgical sciences are still in their infancy in India. It was Sir J. N. Tata who laid the foundations of these at Bangalore and at Sakchi (now known as Jamshedpore) in the beginning of this 20th century.

Under these circumstances when we could not manufacture machines nor had advanced in Industrial Chemistry, when capital was shy and had become more so owing to the Banking Crisis of 1913-14 and when trained and skilled labourers and organisers could not be had, it was not possible for us to take any real advantage of the situation created by the outburst of War in Europe. We had not done any research work as to which materials were available, for what they were suitable, what their properties were and what could be manufactured out of them. The natural resources there were, but we could not turn them to any account except by hand and then only where the secrets of work by hand had survived and except by hastily improvising existing machines and their materials for the purpose in hand.

The Indian Ruralisation and the British Policy of Free Trade.—India is mainly agricultural. Agriculture for the most part depends upon rains. Rains are fitful. Agriculture is therefore unstable. And since there can be no dependence on unstable things, people suffer for want of prosperity.

During the last 40 years India has become more and more rural. In 1871 roughly about 50% of the population derived its sustenance directly from agriculture. Now according to the Census figures of 1911 this proportion has risen to 73. Even during the last 20 years India has become approximately 11% more ruralised as the following figures gathered from Government Census Statistics show:—

Population Directly Engaged in Agriculture.

	1891	1901	1911	Increase		
				1891-1901	1901-1911	1891-1911
	%	%	%	%	%	%
British India	62	68	73.5	6	5.5	11.5
Native States	57	60	67.8	3	7.8	10.8

The above figures point out that the rate of ruralisation in the first decade was twice as much in the case of British India as in the Native States, while in the second decade the tables had been turned and Native States were being ruralised at a rate 50% as fast as British India, so that on the whole during 20 years British India had become 11.5% and Native States 10.8% more ruralised, but still the Native States were 5.7% less ruralised than British India.

We should not shut our eyes to this tendency of universal ruralisation manifested in India. I say, it was bound to be so. Can you expect any other thing when over 60% of our imports of manufactured goods, till before the war, were supplied by the United Kingdom? The policy of the Government of India in regard to Trade and Industry was subject to the mandate of the Secretary of State for India who was bound to be guided by the policy of His Majesty's Government.

Now precarious rainfall causes famines. Famines in India mean, to a large extent, not scarcity of produce, but scarcity of resources. This connotes deepening poverty and brings to light the evil effects of absolute dependence on one thing. The Famine Commissioners recommended diversity of occupation. The people pressed for a vigorous Industrial policy, but the hands of the Government of India were tied by the British Policy of Free Trade.

Failure of Swadeshi—When Bengal was partitioned and a wave of Swadeshi and Boycott of European goods overran the whole country, the people tried their best to do what they could, but they miserably failed and this failure deepened their conviction that unless the Government backed up industries, at least in the initial and preliminary stages, nothing could be done, so far as Industrial development of the country was concerned. The truth is that our attempt was at best a makeshift and haphazard and there were various factors such as railway freights, the dumping foreigner and import and export tariffs which could be controlled by the Government alone and which were injuriously affecting our Industrial growth. Then research work, expert knowledge, advice and guidance could best be undertaken and provided by a Government agency which had resources at its command to do these things satisfactorily. The pioneering work in the Industrial field, which requires patient work and a lot of not immediately remunerative expenditure of money and which is beyond the means of private agencies, generally because they cannot afford to sink

their capital in enterprises which may not be remunerative to them but which provide sufficient experience to make another venture profitable, had not yet been done and it awaited the cooperation of both the Government and the people to undertake it.

Change in Policy.—The war served as an eye-opener both to the Government and the people. It showed how far we depended for essential things on foreigners. As the war dragged on its terrible course the Governments both of England and of India became alive to the necessity of utilising this country's resources for the purposes of war and of so conducting the affairs of the country that in case of future wars India be altogether self-sufficient and be able to act as a pivot for the defence of His Majesty's dominions in the East.

! So under the stress of military necessity the old theory that Industry should be left to look after itself met a natural death. Supplies of essential articles had been cut off and the shortage of shipping and the dangers of the deep precluded their supply from Great Britain, supposing that Britain could spare them, which as a matter of fact she could do with difficulty as her hands were so full with matters requiring immediate attention nearer Home. Under these circumstances Industry in India could not be expected to supply them by looking after itself. Industry in India was yet in its infancy. So the Government took the lead and came out to kill two birds with one stone (which she had been forbidden to do by Cobdenism)—to give effective help in the prosecution of the War by developing Indian resources and thus give an impetus to the Industrial Development of the country.

“ The result is that the air is full of new schemes and the country of new enterprises which are being rapidly developed. Public opinion is veering round from its former indifference or satisfaction to a discontent which means to see that India becomes in future self-supporting so that its commerce, trade and industry do no longer remain dependent on external supplies.”

Section 2.**What we have achieved.**

In spite of all drawbacks and handicaps we have been able to do something. The War stimulated Industry as well as Enterprise and the interest of the Government added fuel to the fire. The lead of the Government showed us the way. Before the war about 80 % of the goods imported were manufactured articles and their value was about 150 crores of rupees. Of the goods exported only 22 % were manufactured and their value was only 50 crores. Now the percentage of the imports of manufactures has fallen to 73 and their value to little over 100 crores, while on the other hand the percentage of the exports of manufactures has risen to as much as 36 and their value to well over 75 crores. The following figures of imports and exports of wholly or mainly manufactured articles support the view that we are becoming more and more manufacturing and less and less dependent on imports of foreign manufactured merchandise.

Critics may point out that decreases in imports of manufactures were due to difficulties of shipping, freight and the fact that Enemy countries could not at all export anything to us, while the Allies had not much to spare and that when these causes would not be in operation, imports of manufactures would again increase and prove to be the ruin of what we have done during the war. In fact they say that it was the fear of after-war relentless competition that constantly weighed with the enterprisers all along the war, which they thought might come to an end at any time, and prevented them from embarking upon new enterprises.

To such critics it may be pointed out that the fact of increased amounts and numbers of articles being manufactured within the country points at any rate to the fact that our dependence on foreigners for manufactures is lessening and that it is due to the cause of our having been successful in improving the old and in starting many new industries. There is no doubt that our enterprisers and capitalists might have done better if they could have had a better and true appreciation of the

situation. There is however no truth in the assumption that after-war competition will make null and void our achievement during the war. The change in the 'angle of vision' of our Government and the change in the policy, an earnest of which we have already had in the duty on the export of raw hides and skins may be trusted with confidence to look to that. With Industries as a transferred subject and virtual fiscal autonomy it seems preposterous to entertain any fear of that catastrophe.

Now let us see what the cooperation of the people and the Government has achieved for us.

Articles Wholly or Mainly Manufactured.

(In crores of rupees)

	Pre-war year.	War years.					Average 5 war years
	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19	
Imports...	145.15	106.66	93.51	109.46	109.92	123.24	108.56
Exports...	54.59	46.58	63.21	76.97	72.72	87.48	69.63

The above figures bring out clearly the fact that we have been, all along during the war, decreasing the imports of and increasing the exports of articles mainly or wholly manufactured. The latter fact points to our increasing capacity of subjecting the raw materials, exported, to the process of manufacture. If we take the figures for 1918-19 and compare them with those of 1913-14, we find that in 1918-19 we imported goods worth 123.24 crores of rupees against 145.15 crores in 1913-14 or 21.91 crores less. On

the other hand our exports amounted to 87.48 crores in 1918-19 as compared with 54.59 in 1913-14 or 32.89 crores more. If we compare the average of 5 war-years, with pre-war-year, we find that on the average we imported 36.59 crores worth of goods less and exported 15.04 crores worth of goods more.—

Again finding the difference of each of the war years with the pre-war year, both in case of exports and imports we find that during the 5 war years we made a saving of 183 crores of rupees on imports and a gain of 75 crores on exports. Multiplying by 5 the difference of the average of war years and pre-war year gives us approximately the same figures. But it might be said that we ought to compare the average of 5 war years with the average of 5 pre-war years to get a more correct appreciation of the situation. Here are the figures.—

(In crores.)

Manufactures.	Pre-war 5 years' average.	5 war years' average.	Increase + Decrease —
Imports ...	121.68	108.56	— 13.12
Exports ...	52.69	69.63	+ 16.94

Even these figures show that it makes a difference of 65.6 crores in favour of India on imports and of 84.7 crores on exports, i. e., compared with the average of 5 pre-war years we imported over $65\frac{1}{2}$ crores worth of manufactured goods less during the 5 war years and exported about 85 crores worth of goods more during the same period. This amounts to saying that India made a gain of 150 crores of rupees on account of war during the five years 1914-19. This amount of money must have done something to develop our industries.

The Position can however, be better realised, if we consider the same things by means of percentages. The following table gives imports as well as exports of articles wholly or mainly manufactured as a percentage of total imports or total exports in each case :—

Articles Wholly or Mainly Manufactured.

(Percentages.)

Pre-war year.	Average 5 pre-war years.	War years.					Average 5 War years.
		1913-14	1914-15	1915-16	1916-17	1917-18		1918-19
79.3	77.7	77.5	70.8	73.1	73.2	72.9	73.5
22.3	23.0	26.2	32.8	32.4	31.2	36.6	31.8

Upper line—Imports.

Lower line—Exports.

The above figures show that our imports of wholly or mainly manufactured articles were on an average 5.8 % less as compared with pre-war year or 4.2 % less as compared with the average of 5 pre-war years. On the other hand our exports of manufactures were on an average 8.8 % more as compared with the average of 5 pre-war years and 9.5 % more as compared with the pre-war year 1913-14.

The year 1918-19 was the most favourable, as compared with the pre-war year, imports of manufactures being 6·4 per cent less and exports 9·5 per cent greater. If exports of manufactures were taken as a sign of the country's manufacturing power, they show that War has made us approximately 9 per cent more industrial than we were before it.

Again, if we compare the shares of principal articles in our export trade during all these years, we come to very nearly the same conclusion.

Share of Principal Articles in our Export Trade.

Articles.	Pre-war average of 5 years.	War years.					Average 5 war years.
		14-15	15-16	16-17	17-18	18-19	
1. Food Grains	21	16	15	15	23	17	17
2. Cotton raw	15	18	13	15	18	13	15
3. Hides & Skins	7	7	8	10	6	8	8
4. Tea	6	8	10	7	8	7	8
5. Seeds	11	8	5	7	4	5	6
6. Jute	19	23	28	25	21	27	25
7. Miscellaneous	21	20	21	21	20	23	21

Figures in the above table are given in each case as a percentage of our total exports in each year. Comparing the figures for 1918-19 with the pre-war average of 5 years, we find notable increases in hides and skins, tea and jute and notable decreases in food grains, raw cotton and seeds.

Comparing the average of 5 war-years with that of 5 pre-war years, we find that we exported on an average 4 per cent less food grains and 5 per cent less seeds. This means that at any rate War gave impetus to the oil industry. Again our exports of hides and skins were on an average 1 per cent, of tea 2 per cent and of jute 6 per cent more than the pre-war average. From this we infer that increased tanning was done in the country and leather and leather goods were manufactured on a greater scale than before the war. Prosperity of tea and jute industries was patent to all and is well borne out in the above figures.

If we consider over what has been given above, we cannot resist the conclusion that War stimulated Industry and Enterprise in India and did a lot of good by making labour more efficient, capital more productive and organisation more specialised and skilled.

Section 2.
War-Efforts.

The Indian Industrial Commission—With the object of examining the possibilities of Industrial development in India, in may 1916, the Government of India appointed an Industrial Commission with the following terms of reference :—

- (a) Whether new openings for the profitable employment of Indian capital in commerce and industry can be indicated.
- (b) Whether and, if so, in what manner, Government can usefully give direct encouragement to industrial development.—
 - (i) by rendering technical advice more freely available,
 - (ii) by the demonstration of the practical possibility on a commercial scale of particular industries,
 - (iii) by affording, directly or indirectly, financial assistance to industrial enterprises, or
 - (iv) by any other means which are not incompatible with the existing fiscal policy of the Government of India.

After 2 years' labour the Commission submitted its report in 1918 and action on it is being taken. His Excellency, the Viceroy, in his speech at Madras, recently delivered, hoped that a vigorous industrial policy would solve many of our difficulties and the foundations of a new Industrial Era would be laid deeply and surely in the near future.

The Munitions Board—In December 1916, His Excellency the Commander-in-chief initiated an inquiry as to whether more could not be done to develop India's resources for War purposes, so that the United Kingdom be relieved of meeting, as far as possible, extraneous demands.

On February 1st, 1917, the Secretary of State for India expressed his desire that further efforts be made to develop India's resources for the supply of the forces in India, Mesopotamia and Egypt.

As a sequel of the above, the Indian Munitions Board was established on February, 16, 1917. It started work on the 1st of April 1917. Its primary object was to develop India's resources for the purposes of war, but the general industrial development of the country and the possibility of future development were not overlooked.

The main functions of the Board were as follows :—

- (1) To purchase in India articles and materials of all kinds needed for the Army, Civil Departments and Railways,
- (2) To divert orders for articles and materials, usually sent for from foreign countries to manufacturers in India,
- (3) To assist in the establishment of new and development of old industries both directly and indirectly.
- (4) To disseminate information and expert advice.

The organisation of the Board—The Board had a number of branches which looked to the purchase of different sorts of articles required for the purpose of War. The two branches which have, in my opinion, done more than any others for the development of Indian industries were Home Indents and Priority Branch and Intelligence Branch, the former by refusing to forward orders to foreign countries for those things which could be manufactured in India and the latter by serving as a Clearing House of Industrial information. This policy compelled demand to look to Indian sources of supply. To make this policy fruitful the Board helped the manufacturers or intending manufacturers by giving them expert advice and guidance and by enabling them to get raw materials from within the country and machinery from abroad whenever possible and practicable.

Expenditure of the Board—The expenditure of the Board for 18 months up to 30th September 1918 was as follows :—

(*Figures in thousands of rupees*)

Items	April 1917 to March 1918	April 1918 to Sep. 1918	Total 1½ years.
Establishment	17,64	27,46	45,10
Supplies of Stores	8,35,62	12,46,93	20,82,55
Factories	4,79,91	8,33,37	13,13,28
Miscellaneous	3,02	...	3,02
Total ...	13,36,19	21,07,76	34,43,95

Of 8.3 crores of rupees spent during 6 months ending September 1918, on factories, 47% was paid to purely Indian firms, 26% to purely European firms and 27% to Joint Stock Companies, which include cotton mills which are mainly Indian and the jute mills which are European in management but composite in shareholding. Further over a crore a month was paid for hides and leather almost entirely to Indian firms. Thus the thirty-four crores paid out by the Board in 1½ years must have given assistance to the development of Industries in India. This is clear from the developments that have been effected in the Textile and Timber trades, the Tanning and Leather industry and the Tata Iron and Steel Works.*

* With the improvements that have been made and the developments that are going to be effected it is expected that these works will be able to supply ½ of the total demand for iron and steel as well as make possible the establishment of many subsidiary industries including the manufacture of machinery.

Opportunities given by War for the development of manufactures.—What opportunities the War has given for the development of manufactures in India can be gathered from the following list of articles for which the Board directed Indentors to look to the Indian sources.—

Acids, carbolic, sulphuric and hydrochloric; caustic soda, magnesium and zinc chlorides; filterbag sheaths; brushes and brooms of all kinds; leather and cotton beltings; boiler composition; bolts, nuts and rivets; locks and padlocks; galvanised buckets; buttons; jute pickers; cast iron pipings; lamp chimneys and globes; chrome leather; fluids, disinfecting and soldering; fire-bricks; glass dishes, jars and other surgical instruments; cutlery; oils and lubricants; leather goods of all sorts; metal polish; paints and varnishes; soaps; tea chests and tea lead; twine and thread; paraffin wax; cotton webbing; ship fittings; mill gears; cast iron wheels; wooden handles for tools; hand tools and machinery spares of all description.

Sound growth of indigeneous industries depends on the growth of chemical industries. So the Board directed its attention to their development and in January, 1918 called together at Lahore, a conference of chemists. It is pleasing to note that as a result of their labours the following chemicals have been produced for the first time on a commercial scale and put on the market:—Caustic soda, magnesium chloride, red lead, thymol, sandalwood oil and zinc chloride.

Further, the Board has paid special attention to the development of what are called "key industries", e. g. production of sulphuric acid, alkalies, salts and milling accessories, many of which are now being manufactured with success in India, making many industries independent of imports. Besides, considerable attention has been paid to the manufacture of anti-friction metal, ferro-manganese (which is now exported on a large scale) glass, pottery, refractory bricks, disinfecting fluids, tea-pruning knives, teachests and graphite crucibles.

Last of all, the Board has examined the possibility of the manufacture of certain important articles on a large scale and it is hoped that these researches will eventually lead to the establishment of various basic industries which will hasten the industrial development of the country. The following is the list of industries which have either been started or are soon going to be started: —

Coal tar distillation; rolling of steel plates and making of galvanised sheets and tinplates; refining of copper and zinc; making of steel tubes and piles; manufacture of agricultural and textile machinery; railway wagons; electrical plant; steel wires; cutlery and enamelled ware and production of steel castings and ferro - alloys in electrical furnaces.

Hindrances to the development of industries—The Board points out that the development of industries in India would have been much greater if the following hindrances were not in operation: —

- (1) Difficulty of getting machinery from abroad.
- (2) Shortage of good quality coal and coke, railway wagons and coasting vessels.
- (3) Difficulty of getting from abroad chemicals and chemical experts.
- (4) Shortage of skilled labour.

It is hoped that now that the war has ended, these hindrances will be overcome and Indian Industrial Development will proceed apace.

The Principle on which development has hitherto proceeded—The development of India's resources for war purposes brings out the following principle on which development has hitherto proceeded—A need has arisen, some source of foreign supply has been cut off and immediately private enterprise assisted or directed by the State has come forward to replace it.

Section 4.**INDUSTRIAL DEVELOPMENT IN PROVINCES.****Bengal.**

Bengal is the richest province of British India. It subscribed about $\frac{1}{2}$ the total amount of Indian War Loans. In popular opinion this is because the province enjoys the blessings of the Permanent Settlement.

In Bengal there has been great progress in the manufacture of *Jute-milling accessories* and in *tanning and leather industry*. Two new chrome tanneries have already been started and one of these, the National Tannery, is also making its own *chromate salts* from the raw ore obtained from the mines in the Singhbhum District which is destined to become, in the near future, the metallurgical centre of India.

Bengal is now manufacturing *tools and implements required by the Tea Industry* which were formerly all imported from foreign countries. *The first knife made from Indian steel* was produced by Butto Kristo Paul and Co. There is every prospect that the machinery actually in use in the manufacture of tea, never made in this country, will now be made by a branch of a British firm.

In the *Engineering Industry* there has been great development, since the country was thrown on her own resources and since constant demands were made upon her from Mesopotamia and East Africa for mechanical products, in the production of which much ingenuity was displayed.

Manufacture and repair of all kinds of electrical machinery are now undertaken by both Indian and English firms in Calcutta, e. g., enamelled wire, vacuum brake material, electrical and medical porcelain.

All kinds of jute-milling machinery, agricultural machinery, brass and gun-metal work, production of baling presses, lathes of all sizes, milling machines for cloth, steam hammers, winding engines and drying machines for roping are produced or are going to be produced by Indian, American and European labour and capital.

Further, there has been great development in the production of chemicals in Calcutta, e. g., Messrs. Andrew Yule & Co., manufacture caustic soda. The Bengal Chemical and Pharmaceutical Works are making thymol from ajwan seeds, refined saltpetre and potassium carbonate as well as surgical dressings and fire extinguishers (hand). The North West Soap Factory is in a position to supply glycerine, carbonate of potash and caustic soda.

Another new line of development is the manufacture of fire-bricks and silica-bricks which are required to line the furnaces of Iron and Steel Works.

Last of all, there has been some development, by hand, in the manufacture of dousuti for tents, tapes, khaki webbing and buttons.

Madras.

Industrial development in Madras has not been on the same scale as in Bengal, but the effect of War has been felt in many ways. It has tended to make the Presidency more self-supporting and less dependent on foreign supplies of essential articles. It has, no doubt, arrested the development of some industries, but at the same time it has diverted energy into new channels and opened up new possibilities.

The tanning industry has been greatly improved and demand for leather accoutrements for the Army has stimulated the production of finished leather.

In connection with the *mill-weaving industry* it is satisfactory to note that the mills are now making their own *chrome alum* (from bichromate of soda) for dyeing fast khaki, *turkey red oil* (from castor oil and sulphuric acid) and *wooden articles and thread*, all of which were formerly imported.

One of the most interesting developments has been the making of thread. Expensive as well as extensive experiments had to be made owing to urgent war demands, to produce thread from Indian cotton, the yarn of which had to be doubled, polished, singed and spliced instead of knotted and spooled. The necessary machinery had to be invented and made and eventually 3,500 lbs. of thread were supplied monthly to the Army.

Another result of war in Madras has been the organisation of a tent, tape and webbing factory which employs only handlooms.

Achievements in the Engineering line have been as follows:—

1. Iron beadsteads for Hospitalship, "Madras."
2. Sugar-cane crushing machinery for the East India Distilleries and Sugar Factories.
3. Screw-cutting lathes.
4. Galvanised Iron water-bottles, brass cooking sets, and gun-cotton cases for the Army, turned out by the Indian Aluminium Company, which could not carry on its own work for want of aluminium sheets and circles.
5. Articles for the Ordnance Department, to turn out which a new company, the Metal Fittings Manufacturing Company was formed.

6. Oil Engines. 30 different kinds of cylinders for motor cars and engines, etc, turned out by Messrs. George Brunton & Co., Cochin, who have now turned out a whole motor, the first motor built in India, equal in efficiency to the imported.
7. Machinery for brick and tile works.
8. Suction gas plant producer, constructed of re-enforced concrete instead of the usual rivetted steel plates.
9. A number of accessories of electric companies.
10. Pruning knives and other estate tools.
11. Looms and loomparts.
12. Hydraulic pumps for a coir yarn press.
13. Iron rounds and flats.

Further, efforts have been successfully made to produce oils on a large scale. Messrs. Tata & Sons have already floated a company for the manufacture of *edible oils and fats* and that new product of cocoanut oil, called "*Cocotine*" which has practically displaced the use of *ghi* in European households. In connection with this it is satisfactory to note that there is bound to be a considerable development in *soap-making* in Southern India, where there is already a school maintained by Government to teach soap-making in all its aspects.

In Travancore, great success has been attained in manufacturing *lubricating mixtures* from indigenous oils and fats. The Paper Mill in Travancore which, for 20 years, had struggled against adversity, has now been put in order, is manufacturing brown paper from *bamboo-pulp* and has been sold to a private syndicate.

Mysore which was the greatest exporter of sandalwood has now prohibited its export and in its stead has put on the market *Sandalwood oil* which has been successfully produced on a commercial scale and has considerably added to the state revenues.

The output of *hydrochloric* and *sulphuric* acids has trebled since the war and *nitric acid*, *epsom salts*, *green copperas*, *disinfecting fluids* and *ink* are also being manufactured.

Pencils and *copying inks* have already emerged out of the experimental stage. Experiments are being tried with *carbon brushes*.

The manufacture of *glue* from tannery flushings has been taken up by a private firm, assisted by the Department of Industries and promising results have been obtained.

Important improvements have been made in the manufacture of *salt*.

Last of all, the war has led to the revival of the building of *wooden sailing vessels* for the coasting trade at Calicut, Cochin, Allepy, Cocanda, and Maslipatam.

Bombay.

The presidency of Bombay may be said to be the fountain-head of Indian Industrialism. Blessed was the day when the Parsees first set their feet on the soil of India and made her their home. It is due chiefly to their enterprise that the Presidency is recognised in the Industrial World as *the centre of textile manufacture in India*. It will be a mere truism to say that the Parsees are the true pioneers of modern Industrialism in this land of Rishis.

Another fact not so well known about this Presidency is that the *Swadeshi movement* which started in 1906 and passed through various stages, from a sentimental boycott of all European goods to reasonable aspirations towards

Industrial training and enterprise, first took shape in this very Presidency in *the Talegoan Glass Works*, where under Japanese supervision young boys were given industrial education and fairly trained glass-blowers have since been successively distributed all over India.

Various other small industrial ventures have been mostly organised by men who show themselves quick at absorbing new ideas but somewhat volatile in their rapid changes from one industrial process to another. A match factory is undertaken, but after sometime it is transformed into a slate-pencil-making concern and is then finally wound up with experiments in tile-making. This has been *the course of early attempts at Industrial progress*, but recently there has been great improvement, manifestly due to War.

Special attention has been paid to the development of *oil industries*. As in Madras they manufacture a substitute of *ghee* in "Cocoatine," so in Bombay they have taken groundnut and after extracting oil, ground the cake into flour and used it for making biscuit and bread. They have christened the new product "*Nutramine*" because of the high nutritive value of the flour on account of its protein contents.

The *Dairy Industry* in Bombay has been given a considerable fillip by the high prices obtainable for *Casein* which is got from curds. The original works for its manufacture were set up by a German who had given out that casein was protected by patents and nobody else could manufacture it. Now all this has been exploded. The product is very important on account of its unlimited technical applications among which may be mentioned the following:—

1. It is a principal constituent of a large variety of paints, which retain their colour and usually resist climatic influences.

2. It is used as an adhesive and cement and a Bombay firm is already manufacturing a good glue out of it.
3. Plastic masses of it have been employed in Europe as a substitute for horn, ivory and celluloid, etc.
4. It is employed in the textile industry as a dressing and colour-fixing medium and promises to supply a long-felt want in the Bombay Presidency.
5. It has an extensive field as an article of food for infants and invalids.

In *tanning* the Presidency under the direction of Government has shown the way to greater possibilities in the near future.

The combination of sea-water and cheap electricity is *Bombay's greatest asset*. The real industrial future of the Presidency is bound up with water-power facilities. The numerous enterprises of that great Industrial Leader, J. N. Tata are carving out the method for the supply of cheap electricity from water-power and this will enable Bombay to produce aluminium from *bauxite* and possibly *calcium carbonate* and *cyanamide*.

While the war has hindered the progress of hydro-electric schemes, it has assisted to promote other industries. *Five new glass works* have been started in the Bombay city itself, where there was none before. They have improved the quality of their goods but there are difficulties in the way *e, g*, cheap fuel is wanting, trained glass-blowers are scarce, Japanese crucibles which they use are bad, while the sand for lampware they get from Allahabad. But the main difficulty is fuel. *Experiments with oil-fuel* seem to be promising, while *investigations in pottery* give an early hope of making crucibles locally.

Unlike Calcutta, in Bombay there are few British firms ready to take lead in industrial enterprises. *Engineering and Chemical works* are handicapped by their distance from coal and iron. But there are signs of change. Considerable extensions are under contemplation by the Eastern Chemical Company which is already producing *caustic soda* of a very high degree of purity. *A very considerable amount of research work has been done* with a view to the utilisation of indigenous raw materials in the manufacture of products formerly imported.

Another industry brought into prominence by the war is the saw mill industry which has expanded considerably during the last few years. *Timbers suitable for aeroplanes* have already been supplied to England and Egypt.

In fine, there have been discovered ample deposits of *suitable clays* for making tiles, bricks, pottery, not far from Bombay and a *thorough investigation of pottery possibilities on a commercial scale* is now under consideration. In fact small factories have already been started by private enterprise and with improvements in method they may be expected to survive.

U. P.

The Industrial capital of the provinces, Cawnpore, has figured prominently in War work, both as regards its war loans and the supply of *textile and leather manufactures* of all sorts for the Army, boots, harness and saddlery.

U. P., may claim to have supplied the bulk of the *tents* for the Army.

Further, demand for *webbing, tape, newar and handmade blankets* has given employment to numbers of village artisans at Muzaffarnagar, Najibabad and Bijnore.

A comparatively new line of manufacture in the shape of *shoulder-titles* has been established upon a large scale at Aligarh which has also supplied large orders for *cutlery and claspknives*.

Rollerskins used in cotton-spinning, *leather-belting* and *pickers* used in all textile mills and *wash leathers* have all been produced in the Provinces equal in efficiency to imported ones.

There has been great expansion of the *tanning and leather industry*. An up-to-date factory for the manufacture of *kutch* (for dyeing khaki) has been established. *Refining of tallow* has achieved success. Manufacture of *glue* is being taken up. *Leather buttons* have been supplied in large numbers. *Rosin and turpentine* are manufactured on a large scale by the Forest Department.

Great progress has been made in the manufacture of glass, near Allahabad. A new glassworks has been started at Moradabad. At Naini a large tank-furnace has been installed, this being the only one of its kind in India. Feerozabad takes lead in the manufacture of glass bangles, but is faced with a serious competitor in Japan. Glass-manufacture requires *alkali* in the form of *sodium carbonate* and now a large factory has been set up at Cawnpore which produces 2 tons per day from *veh*, the efflorescent deposit on *usar* lands.

The Punjab.

The Punjab is the agricultural province of India. Irrigation canals have made it so. Three-quarters of the wheat exported from India to Europe ordinarily comes from this province. Demand for labour for agricultural purposes is out-stripping the supply. Nevertheless the Province has developed some of its industries very considerably during the war as the following account will show.

Dhariwall and Egerton Woollen mills have worked day and night, like Cawnpore mills, to supply War requirements. In addition Panipat and other places have produced large numbers of *blankets* and it is said that even the best workers have improved the quality of their product. Ludhiana has turned out large quantities of some important military equipment, e. g., water bottles, haversacks, puggeries and shoulder-badges.

The manufacture of *tents* has received a considerable impetus at Ferozpoore. *Puttoo cloth* and *Lohis* have been turned out by handworkers-in-cotton who have learnt to weave wool on their looms. Enormous demand for woollen goods of all kinds has been met and the experience gained must do immense good in future.

The *Punjabi carpenter* has acquired a well-merited reputation and has justified it during the war. The carpenter as well as the *blacksmith* have done quite new work, never under-taken prior to the war. They have produced *bedsteads complete with springs*. The value of work carried out in wood and metal for the Army was about 3 lacs of rupees per month. In *culery* they have proved excellent workmen, producing remarkably cheap articles of good quality.

Further, the manufacture of *salt-petre* by country methods has increased considerably.

Among *minor industries*, *dyeing* by country methods has assumed considerable importance, so that the Government has opened a *dyeing school* at Lahore.

The *Ambala Glass Works* specialise in *chimneys* and supply the whole of the Punjab and the North West Frontier Province. Another glassworks has been recently started at Lahore.

To supply *drugs* manufactured of country herbs, an enterprise has recently been started.

All this goes to show that during the war the efficiency of labour in the land of Five Rivers has increased much owing to better training received in War work.

Burma.

So far as *industries* are concerned Burma is very backward. It is handicapped for want of 3 factors--

1. Shortage and high cost of labour.
2. Want of cheap fuel.
3. Pancy of roads and railways.

Burma is *rich in natural resources* but few of these are worked up in the province itself. Rice, timber, hides and skins, mineral oil and cotton form its *chief exports*, while the *imports* are all manufactured goods. The only raw materials imported for manufacture are tobacco and silk.

Burma is *one of the great Indian reservoirs of grains*, the other two being the U. P., and the Punjab. Its exportable surplus of rice forms $\frac{2}{3}$ of its total exports. *So the industrial economy of Burma is still mainly agricultural.*

Burma is a *great reservoir of timber* of which even before the war there seemed to be a world-wide shortage, but manufactures of wood are practically non-existent.

Burma is *rich in minerals*. There we have *mineral oil, lead, zinc and silver ores, tungsten, tin, antimony, copper, rubies, and sapphires*. The Tavoy district of Burma is *the most important of the world's tungsten areas*. Antimony and copper are not yet worked. The mining industry has been developed mainly by British capital.

Whatever capital there is in Burma belongs to the Chinese, the Indian or the British. *There are practically no banks in Burma*, except a few branches at Rangoon. Labour is also largely supplied by other sources than the Burman. Burmese like an open-air life and are reluctant to submit to the discipline of organised industries. Fuel is a great handicap, but Burma has great possibilities of hydro-electric development.

Owing to its remoteness from War-theatres, the effect of War was less marked in Burma than in other Indian provinces. But Burma supplied very large quantities of *timber* and the *manufacture of munitions of some simple kinds* was also undertaken. The success attained gives hopes of great future possibilities.

Shipbuilding drew some attention in Burma and many wooden ships have been made and are still being made.

Prospecting is continually going on, but survey work is hampered by dense forest growths.

Among chemicals, sulphuric acid and caustic soda are being manufactured.

Paper pulp and paper manufacture has also been started. Demand for matches is met locally. Possibilities of establishing rubber and cotton manufactures are being enquired into.

There are great possibilities of establishing the following industries in the near future:—

Oil, tea, tobacco, sugar, starch from rice, lead manufacture, cement, tiles, earthenware and porcelain, soap, cordage and gunny products, matting, sea-fishery as well as pearl-fishery.

Central Provinces.

Of all the provinces the effect of War has not been as exhilarating on the industrial development of C. P., as on that of other major provinces, owing to—

1. Uncertainty of the market.
2. Difficulties of transport.
3. Shortage of skilled labour.
4. Difficulty of getting machines and stores.

All these drawbacks were operating in other provinces as well, but while other provinces surmounted them to some extent, C. P., could not.

Agriculture is the key industry of the province.

Indigenous manufactures could not develop for want of iron and machinery. Development of sugar-cane cultivation had to be stopped for want of cane-crushing mills.

It has also been impossible to develop the commercial potentialities of important minor forest products such as lac, but on the other hand, collection of tanstuffs has received great impetus from War demands and has been put on a more scientific and commercial basis than formerly.

The *mining industry* has also suffered. *Coal* and *manganese* industries were dislocated by War and their expansion impaired owing to the causes, mentioned above.

Small industries like *cement*, *pottery* and *glass*, have profited by the war and been firmly established. *Oil pressing* was a possible industry, but its development was retarded by some of the causes noted already.

Further the agricultural chemist succeeded in manufacturing *paper from cotton stalks*, but for want of machinery has not been able to demonstrate its success on a commercial scale. Machinery ordered was sunk at sea and never replaced.

Cottage industries like cotton and wool-weaving have benefited by high prices, but the benefit has been counter-balanced by high prices of raw materials. *Fly-shuttles* have been introduced in cottage handlooms and have also been locally made. They have, however, good prospects before them as has the *Brass-work* which suffered partly from shortage of brass and partly from the difficulty of getting the necessary plant.

'*Koshta*' a silk-embroidered cloth is a speciality of the Central Provinces. It does not compete with mills, but high prices have lessened the demand considerably.

Bihar and Orissa.

There are several industries, great and small which have immensely benefited on account of the conditions arising out of the war. Also there are some which have been hit hard owing to the dislocation caused by the same.

The *mining industry* of the province has received a very great stimulus from the war. Several divisions of the province have enormous mineral wealth. The Chotanagpur division and the Singhbhum district have received great attention and have attracted more capital than other parts. There seems to be every prospect of great future development. Prospecting has proved that Singhbhum contains

large deposits of iron, manganese and copper ores, fair deposits of gold, chromite, phospheric rock, phosphate of lime, yellow and red ochre, wolfram, china clay, lime and limestone and minor deposits of asbestos, mica, lead ore, soapstone and slate. Prospecting continues on behalf of the two companies already settled there, viz., Messrs. Tata and Company and the Bengal Iron and Steel Works and on behalf of Messrs. Burn and Company for the Indian Iron and Steel Company and Messrs. Bird and Company for a new syndicate. *Jherria coalfields* have been particularly prosperous. A *tin mine* has already been opened and concessions for *copper* granted. *Mica* and *red oxide of iron* have received great stimulus from Railway demands. It is proposed to extend the Bengal Nagpur Railway to tap the new *iron-fields*.

Weaving industry—Weaver's cooperative societies have done much towards improving the local weaving industry. Handlooms for weaving cloth have also done well. But the progress of *silk weaving*, *bafta* and *tasar* weaving industry was hampered by the high price of cocoons.

Indigo—This industry received a temporary revival during the last 2 years of War, but is again declining owing to competition from the synthetic dye.

Dyeing—War has led to the revival of local dyeing.

Tanning—The Utkal Tannery at Cuttack, a swadeshi concern started several years ago, has been doing well and the articles manufactured by the Company find ready sale in Calcutta and elsewhere. Another tannery has recently been started by a local Mohammedan gentleman.

Shellac Industry—Owing to want of raw material, several small factories closed down, while larger ones could do but little work.

Brassware—Padlocks and brassware industry showed signs of decline.

A Review of the Survey of Industrial Development in Provinces.

After taking a survey of the Industrial Development in Provinces, we find that the existing industries, which depended altogether on foreign supplies of machines, machine-parts and milling accessories, have become, to a certain extent, independent of imports of those essentials.

Industries, in modern times, cannot be carried on without chemicals. In this respect we find some development, mostly in Bengal and Madras.

As has been remarked somewhere else, Industrial Development would have been much greater, if the supply of machinery and chemicals had not been cut off for all practical purposes. Extension of established industries and the establishment of new ones were both hindered by this cause.

Experimental and Research work has been done on a large scale to show the practicability and prospect of carrying on various industries.

Things never before attempted have been accomplished under the dire stress of military necessity by cordial combination and cooperation between the Government and the people. If the spirit, in which this work of Industrial regeneration was undertaken, continues to influence the working of the new Industrial Department, there need be no misgivings as to the future of Industry in India.

Appendix to section 4

Summary of Industrial Development.

A.—Province by Province :

Bengal.

1. *Engineering*—manufacture of accessories in connection with jute, tea and electric industries and repair of plant and machinery of all sorts.

2. *Tanning and leather*—improvements in tanning, particularly chrome-leather and manufacture of chromate salts.

3. *Chemical*—manufacture of caustic soda, thymol, saltpetre, sulphuric acid, potassium carbonate and glycerine.

4. *Medical*—manufacture of surgical instruments and dressings.

5. *Pottery*—manufacture of silica and fire bricks.

6. *Miscellaneous*—improvements in the manufacture of paper, manufacture of fire-extinguishers (hand). Dhusuti for tents, tapes, khaki webbing and buttons.

Madras.

1. *Engineering*—manufacture of accessories of millweaving industry, mill machinery, engines, lathes, motor, accessories of electric companies, tools of all kinds, looms and loomparts and hydraulic presses.

2. *Chemical*—manufacture of chrome alum, tarkey red oil, epson salts, green copperas, acids and disinfecting fluids.

3. *Tanning*—improvement in the process.

4. *Sapp*—improvement in the process of manufacture as well as a large amount of research work.

5. *Oil*—improvements in refining and manufacture of sandalwood oil etc., and manufacture of 'cocotine'.

6. *Miscellaneous*—improvements in the manufacture of paper, ink, pencils, carbon brushes, glue, salt, and shipping.

Bombay.

1. Improvements in the *Textile Industry*.
2. Improvements in *Oil-pressing* and manufacture of 'natramine.'
3. *Dairy*—manufacture of 'casein.'
4. *Tanning*—improvement in the process of.
5. *Glass*—improvement.
6. *Chemical*—manufacture of caustic soda.
7. *Miscellaneous*—establishment of sawmilling industry, investigations into the manufacture of pottery and crucibles and use of oil-fuel.

U. P.

1. *Engineering*—manufacture of mill accessories.
2. Improvement of *tanning* and manufacture of *leather goods* of all sorts.
3. *Outlery*—improvements and manufacture of clasp-knives.
4. *Glass*—manufacture of chimneys, globes and bangles.
5. *Miscellaneous*—manufacture of tents, webbing, tape, newar, blankets, shoulder-titles, leather buttons, catch, tallow, glue, rosin and turpentine (improvements), and sodium carbonate.

Punjab.

1. *Military Equipment*—manufacture of water bottles, haversacks, gun-cotton cases and clasp-knives.

2. *Textile*—manufacture of blankets, puttoos, and lehias (by hand).

3. *Carpentry and blacksmithy*—cutlery and iron bedsteads.

4. *Glass*—improvement in manufacture of chimneys and globes.—

5. *Drugs*—manufacture started.

6. *Improvements in the manufacture of saltpetre and dyeing* by hand.

Burma.

1. *Mining and minerals*—production of copper, zinc and silver and other minerals.

2. *Chemical*—manufacture of sulphuric acid and caustic soda.

3. *Paper pulp and paper manufacture.*

4. *Match-manufacture.*

5. *Shipping*—building of wooden ships.

6. *Fishery*—tea and pearl, prospects of both.

C. P.

1. *Tanning*—collection of tanstuffs put on a scientific and commercial basis.

2. *Paper*—manufacture from cotton stalk proved practicable.

3. *Miscellaneous*—manufacture of cement and flyshuttles and improvements in pottery and glass industries.

Bihar and Orissa.

1. *Mining*—great development in Singhbhum.

2. *Weaving*—development through cooperation.

3. *Indigo*—improvement in the manufacture of dye.

4. *Dyeing*—revival.

5. *Tanning*—improvements.

B.—By Industries:—

1. Cement—manufacture started and developed in C. P.

2. Chemical—development of manufacture in Bengal, Bombay, Madras, U. P., Punjab and Burma.

3. Outlery—manufacture developed by hand as well as machinery in Bengal, U. P., and Punjab.

4. Dairy—development of 'casein' manufacture in Bombay.

5. Engineering and Electrical—manufacture of some and repair of all accessories of mills and factories, in Bengal, Madras and U. P.

6. Fishery—prospect of development of both sea and pearl fishery in Burma.

7. Glass—development in manufacture of lampware and bangles and glass instruments in Bombay, U. P., Punjab and C. P.

8. Glue—manufacture started with good prospect of development in Madras, Bombay and U. P.

9. Hand Industries—extension and development in Bengal, Madras, U. P., and Punjab.

10. Ink—development in manufacture in Madras and Bengal.

11. Medical or preparation of medicinal drugs—development in Bengal, Bombay and U. P., as well as start made in the Punjab.

12. Mining and metallurgy—development in Bengal and Burma, Bihar and Orissa—production of copper, zinc, lead and silver.

13. Oil—developments in Madras (coccoatine) and Bombay (nutramine) mostly.

14. Pencil—success attained in manufacture in Madras.

15. Paper—development in Bengal, Madras, U. P., C. P., and Burma.

16. Pottery—development in Bengal, Bombay and C. P., manufacture of fire-bricks and investigations as to the manufacture of crucibles.

17. Petroleum—development in the process of refining and extraction of petrol in Burma.

18. Sawmilling—start in Bombay and development in Burma. Aeroplane timber.

19. Salt—improvement in the process of manufacture in Madras.

20. Shipping—development in Burma and Madras.

21. Soap—improvements mostly in Madras.

22. Tanning and leather—improvements and development in Bengal, Bombay, Madras, U. P., C. P., and Bihar and Orissa.

23. Tea—improvement in Bengal and Madras.

24. Textiles—development in Bengal (by hand), Madras (manufacture of thread), U. P. (tents) and Punjab (blankets).

Section 5.**Some Essential Industries.****Chapter 1.—Power for Industries.**

Of the two essentials for industries, raw materials and power, Nature has endowed India abundantly with raw materials for all sorts of industries. It is said that so far as sources of power are concerned, India is relatively poor. Let us see how far this is so.

To carry on industries on a large scale power is required to work the machines or other appliances. This power cannot be efficiently supplied by human beings or animals. The work of, say, grinding corn into flour or sewing or drawing water from wells is now more economically performed by machines to propel which power is generated from—

1. Charcoal,
2. Coal,
3. Mineral oil,
4. Water or hydro-electric energy,
5. Alcohol or Industrial alcohol, to put it more correctly.

Now we shall take each of these, one by one and see how India is situated with respect to each.

I. Before coal was discovered charcoal used to serve the purpose of smelting iron and other minerals in furnaces. Where coal is not available, it can still serve the same purpose. In Mysore they are thinking of smelting iron by first converting wood into charcoal. But this involves the destruction of slow-growing forest, so it cannot be very economical in the long run. Destruction of forest affects rainfall. In a country which is predominantly agricultural this cannot be considered to be a sound policy except in places where there is sperabundance of forests. Even there, we are bound to take exception to the policy, because of world-wide scarcity of wood and timber.

II. Considering coal we find that it is not widely distributed in India. In 1917, 16½ out of 18 million tons was produced in Bengal and Bihar. Therefore those industries, such as chemical and metallurgical industries, which require a very large amount of coal or coke can best develop in Bengal and Bihar. Then Indian coal is not of a very good quality. Supplies of coal in India are no doubt large but only a certain proportion of this is suitable for the preparation of good coke. Impurities such as ash and phosphorous contents are high in Indian coking coals.

III. At present mineral oil is generally used in the form of petrol, kerosine and oil fuel. It is of growing importance. In this War, mineral oil in its different forms has been largely used in military and naval operations, e. g., oil fuel in the navy, benzine and petrol in mechanical transports of all kinds, petrol in aero-engines and mineral lubricants in engines and machinery of every type.

In India this industry is growing day by day as the following figures of India's production of crude petroleum will show—

Year.		Gallons (in thousands).
1890	...	4,132
1895	...	13,004
1900	...	37,729
1904	...	118,491
1906	...	140,553
1911	...	225,792
1917	...	282,760

Area of Occurrence—In India it is confined to 2 areas of folded rocks at either extremity of the Himalayas. The Iranian arc occurring on the West, in the Punjab and Baluchistan and continued beyond British limits to Persia is not yet developed as a commercial undertaking. On the East, the Arakan system occurs in Assam and Burma and is continued to the oil-fields of Sumatra, Java and Borneo.

In Assam the work began in 1899 and production at present is over 6 million gallons.

In Burma, for over 150 years, oil has been extracted by indigenous methods. Even before 1886 the annual yield of oil was generally over 2 million gallons. From 1887 Europeans entered the field and in 1898 employed machinery for the purpose of drilling wells which nowadays go down to a depth of over 3,000 ft. In 1908 the Burma Oil Company laid a pipe line 10 inches in diameter and 275 miles long at a cost of £ 750,000 from their fields in Upper Burma to their refineries at Rangoon, where oil can be delivered at the rate of 520,000 gallons per day.

Petroleum products—Crude petroleum must undergo a process of refining before marketing, undistilled crude oil being used in munition factories for the manufacture of explosives. War has necessitated improvements in the distillation of crude petroleum and utilisation of many of the by-products which were formerly treated as waste and destroyed. Numerous processes have been patented to extract the maximum quantity of petrol from crude oil. The following are the products which refining by distillation yields:—

1. Distilled or safe crude—used as a preservative and disinfectant, as fuel oil and for laying dust on roads.
2. Petrol—for internal combustion engines, motor cars, cycles, aeroplanes etc.
3. Benzine—for internal combustion engines other than air craft.
4. Kerosine (bazar oil)—for ordinary lamps, gas making and engine cleaning.
5. Superior kerosine—for house lighting, gas engines etc.
6. Water white kerosine—superior than (5)—ditto.
7. Heavy residuum—as fuel in place of coal.

8. Pitch—for roadmaking and cable covering.
9. Coke—as fuel.
10. Distilled fuel—for oil engines, stoves and boilers.
11. Lubricating oil—for all types of machinery.
13. Wax—for munition factories and making candles, match-manufacture, for tracing designs on fabrics before immersing them in the dye, paper glazing, egg, meat, and fruit preserving, making modelships for experimental purposes, water-proofing woollen fabrics, and insulating electrical installations.

Burma has contributed its product for each of these uses and it is an indication of the magnitude of the output that its petroleum spirit has probably been in use on every battle front.

IV. *Water power* as well as *wind power* are not now directly utilised for turning machines. The stage in which mills—mostly flour mills—were worked by the force of wind or running water has been superseded. The discovery of steam power dispensed with the necessity of taking advantage of wind power, mostly in demand by sailing vessels. The uncertain was substituted by the certain. Steam as generated by fuel and water remained the source of power for some time. In this combination a great deal of the former is combined with a small amount of the latter. Now the ratio of the constituents of this combination has been reversed. A great deal of water with a small amount of fuel is combined to produce electric energy. Cheap electricity is now an essential for certain chemical operations. An idea of cheapness can be had from the fact that in North America or Scandinavia electricity is generated from waterpower at from 0.1 anna to 0.05 anna per unit, while electric current at 0.5 anna per unit can compete with steam.

India suffers from a considerable drawback in connection with the development of hydro-electric schemes. Owing to climatic conditions there is excess of water during certain months and considerable shortage during the hot season. So that either we must construct enormous dams to hold up the excess water during the monsoons to be used in dry months or the works must be shut down during the periods of draught. The first alternative requires enormous capital making the cost of the current high, while in the second money locked up in valuable plant and machinery will be unremunerative during several months in the year.

This is the general prospect. Wherever water can be had all the year round under the required circumstances, such as on the Western Ghats, Himalayan valleys, and in Burma, electricity may be generated sufficiently cheap so as to compete successfully with steampower. India with its perennial rivers, regions of copious rainfall, and mountainous reservoirs of potential water power is well situated as regards the prospect of development of this source of power. This is very much like a perennial source, in contrast to all the preceding ones which amount to using Nature's limited reservoirs which once exhausted can never be refilled.

V. *Alcohol* in an excellent source of power and in India there is no limit to its production since it is a land of superabundant sunshine which is necessary for the production of carbohydrates which are universal plant constituents. These by fermentation yield alcohol.

This is also an everlasting source, utilising plant life which embodies sun-power which is the one source of all power. Coal and mineral oil represent also sunpower but that which has been conserved by time and age. These reservoirs are limited. Therefore they should be only economically used. For many purposes alcohol or ethyl alcohol or industrial alcohol which can be had in unlimited quantities in India can very well do.

Besides its use as fuel it has innumerable applications in industry. It may be used as a substitute for petrol in ordinary motor cars, small stationary engines and motor boats. Danger from fire is less in the case of alcohol, as the flame can be extinguished by water which only tends to spread the flames of burning petrol. It is clear and odourless and can therefore be used in households as fuel, if it becomes available in large quantities. It will react in favour of agriculture lessening the necessity of using cattle-dung as fuel. It can also be used as an illuminant in lamps of special design.

There are some 500 applications of alcohol in various arts and manufactures. Of these the following may be mentioned:—manufacture of acetic acid, acetates, perfumes, tinctures, varnishes, polishes, ether, chloroform, dyes, transparent soaps and artificial silk.

These are enough to bring out the importance of this source of power. The following are its good sources:—

1. *Mahua* flowers, which contain from 40 to 60 % of fermentable sugar which is distilled into alcohol.
2. Cereal grains.
3. Starch containing tubers, e. g., potato.
4. Saw dust, when available in large quantities on treatment with sulphurous acid under pressure yields fermentable sugar.
5. After sugar-cane has been pressed out, the residue can be treated in the same way as in (4).
6. Molasses for this purpose have been imported from Java as the sugar industry in India has not been in a satisfactory condition.

All things considered, the *mahua* flower would seem to be the best raw material for industrial alcohol in India and since fresh flowers are the best for the purpose, Hyderabad where they can be had in abundance should be the seat of the industry.

Chapter 2—Chemical Industries.

Development of Industries on Scientific Lines depends on—

(1) the presence and availability of abundant sources of supply of raw materials of all sorts,

(2) the presence and availability of good and cheap sources of power,

(3) the knowledge of industrial chemistry or development of chemical industries,

(4) mining and metallurgy so as to get various minerals required for industrial purposes, and

(5) knowledge of making machinery or mechanical engineering as well as electrical engineering.

Of the first factor it might be said that India is the reservoir of the raw materials for some of the important industries of the world. Indigenous raw materials have been exported on a large scale to other countries. The best line of development of industries in India will be to make use of these various natural products within the country.

The second factor has been already dealt with in the first chapter of this section.

The third factor will be the main topic of this chapter.

The fourth factor will be dealt with in the following chapter.

Of the fifth, this much might be said with advantage here. Practically all the raw materials required for mechanical and electrical engineering are indigenous to India. The manufacture of practically all types of machinery and electrical appliances could be undertaken with a certainty of success, as the market is assured. But the resources are not sufficiently developed to compete with imported machinery. The raw material is available, labour can be procured and trained. It remains for private enterprise to avail itself

of the opportunity. A start in this direction has already been made. All machinery required for the Mysore Sandalwood oil factories was made in Madras. Bengal is also not behind Madras in this respect. Establishment of subsidiary industries at the Tatas both by Indian and European Firms has a good augury for the future.

ESSENTIALS FOR THE DEVELOPMENT OF CHEMICAL INDUSTRIES.

The development of chemical industries forms an important factor in the economic life of a modern state. The manufacture of explosives, dyes and drugs, artificial scents and flavours, medicinal drugs, fertilisers, disinfectants and antiseptics and various other chemical substances of great industrial value, depends essentially on the development of chemical science and research. In order to carry on chemical industries certain essentials have to be provided at sufficiently low rates. These are 3 in number—

(1) *Fundamental heavy chemicals, e. g.,* sulphuric and hydrochloric acids, lime, sodium carbonate, caustic soda, ammonia and ammonium salts, common salt, and if a coal tar industry is included, nitric acid. These are essential because they are largely used in the production of other chemicals from indigenous sources, e. g., sulphuric acid is required for the manufacture of hydrochloric and nitric acids, sodium carbonate, alum, metallic sulphates and superphosphate, in refining oils and other natural products and manufacture of dyes and explosives.

(2) *Fuel for heating purposes*—this may be coal, charcoal oil or cheap electric energy where available.

(3) *Chemical plant and machinery.*

Something has been said of the last two essentials elsewhere. Therefore the first alone remains to be treated here and that I shall do at some length so as to bring out its importance. In doing so I shall also include other chemicals and point out their sources, uses and prospects.

1. **Acids.**—Among fundamental chemicals, *sulphuric acid* may be regarded as the "key" industry for all chemical industries. In fact it has been claimed that the wealth of a country can be gauged by its production of sulphuric acid. In India this industry is yet in its infancy as will be clear from the following figures :—

Country.	Production (annual) tons.
United Kingdom ...	... 1,000,000
France ...	... 1,000,000
Germany ...	... 1,650,000
U. S. A. (1912) ...	... 2,876,000
„ 1914 ...	... 3,765,000
„ 1917 ...	... 7,000,000
India (imported) ...	2,000 or 3,000
„ manufactured ...	... 18,000

In 1912, about 70 % of the total amount of sulphuric acid produced in America, France and Italy was used for the manufacture of superphosphates used as fertilisers. The total quantity so used was $3\frac{1}{4}$ million tons. Apart from other considerations, to India provision of cheap sulphuric acid is a necessity for restoring the lost energy of the soil by supplying it with fertilisers.

At present sulphuric acid is made by burning sulphur which is imported from Sicily or Japan, one ton of sulphur yielding about 3.5 tons of sulphuric acid; but the cost by this method is much higher than in other countries. The future of the industry is promising in view of the decision at Singhbhum to work up Burmese zinc ore to produce zinc sulphide which when roasted can be used for the production of sulphuric acid.

Nitric acid is required for the manufacture of dyes and explosives and is prepared from saltpetre, but the possibility of preparing it from atmospheric nitrogen as in other countries requires careful consideration.

Hydrochloric acid is mainly used in the manufacture of chlorides, purification of ores, and in the colour and pottery industries.

Both these acids can be prepared on a fairly large scale, if cheap sulphuric acid is forthcoming.

2. **Alkalies**—Next in importance to sulphuric acid for the development of chemical industries are *alkalies*, sodium carbonate and caustic soda, since little expansion of other industries can take place unless these chemicals are available in large quantities at low rates. Both these *alkalies* are produced in U. P., Mysore and the Punjab; but the present methods, it is feared, will not prove profitable, when the price of chemicals falls.

These alkalies are essential for many industries and among these may be mentioned soap, glass, dyeworks, coal tar and oil refining.

The most dangerous competitor is sodium carbonate from Lake Magadi in East Africa, but if its manufacture in India is looked upon as a "key" industry, it might prove desirable to protect it in the early stages of its development.

3. **Salt**—Common salt or sodium chloride is a substance of fundamental importance both for use in chemical industries and for human consumption. In 1914, about $1\frac{1}{2}$ million tons were produced in India. Of this about 60% was produced from sea water by solar evaporation in the Bombay and Madras presidencies, about 16% from the Sambhar Lake in Rajputana 11% from the rock salt beds in the Punjab, 1% from the salt deposits in Sind, stated to be very extensive, and smaller quantities from the sub-soil water in Gujrat. Salt is also produced as a by-product in saltpetre refineries, but the crude salt is thrown away as purification would not repay the duty which is levied.

Imports—Although very large quantities are made in India, the output is not sufficient to meet the total demand, as the following figures of imports of salt into India will show:—

Year.	Quantity (Tons.)	Value. £
1914-15	4.65 lacs.	49 Millions.
1915-16	5.48 "	1.26 "
1916-17	4.48 "	1.27 "
1917-18	3.36 . "	1.46 . "

It is just possible to increase the quantity of salt manufactured in India so as to make her independent of foreign salt. *Improvement in methods of production* will lead not only to increased production but also to the production of several important ingredients. But there are difficulties in the way. Any improvement in methods of production which might tend to give a heavy salt meets with opposition, because the Government duty is levied by weight while the manufacturer sells by measure and hence prefers a light salt. The salt manufactured in India from seawater is usually not a high grade article. A good deal of it is contaminated with earthly matter and has a brownish colour and leaves a residue when dissolved in water. Also it contains appreciable amounts of magnesium chloride and thus tends to become damp in a moist climate. The quality can undoubtedly be improved, the quantity increased, and ingredients of commercial importance extracted, if the duty is levied also by measure or the salt sold by weight and expert knowledge applied to the manufacturers.

Ingredients of seawater—Seawater from which about 60 per cent of the salt produced in India is made contains the following ingredients per 1,000 parts—

Sodium chloride (common salt)	...	27.25
Magnesium chloride	...	3.29
.. Sulphate or epsom salt	...	2.25
.. bromide	...	0.075
Potassium chloride	...	0.73
Calcium sulphate	...	1.26

BITTERNS—In the process of manufacture, the salt crystallises out leaving behind a liquid known as *bitterns*, which ordinarily contains the salts mentioned above; but in India no attempt has yet been made to utilise them. The general practice is to retain them in the salt-beds, under the mistaken notion that their presence increases the yield of salt, whereas in reality they merely retard the evaporation of brine. At the end of the season they are washed away by the rain. Now the annual production of salt by seawater is not less than 7,50,000 tons. The following figures will show the quantity of other salts washed away:—

Magnesium chloride	...	1,93,000	tons
" sulphate	...	1,27,000	" "
Potassium chloride	...	20,000	" "
Bromine	...	1,800	" "

These substances are all of commercial importance.

Magnesium chloride is used mainly for dressing cotton thread, for making hydrochloric acid and metallic magnesium.

Magnesium sulphate or *epsom salt* is already made and is chiefly used for (a) finishing textiles, (b) medicinal purposes, and (c) the preparation of sodium sulphate.

Potassium chloride is a far more important substance than either of the above and is the starting point for the manufacture of practically all potassium salts. Potassium compounds are required in unlimited amounts for the production of fertilisers. The world supply is not large. Until recently the whole world's supply was derived from Stassfurt's deposits in Germany. American production is now equal to India's potential supply, as disclosed in the above figures.

Except for a small quantity, all *bromine* originated in Germany. British Empire does not produce it at all. So it is important to investigate the possibility. Bromine in the form of potassium and ammonium bromides is of great medical importance. Silver and potassium compounds of it are indispensable for photography and bromine itself is in great demand for the manufacture of aniline dyes.

Extraction—In manufacturing salt, owing to the diminished solubility of magnesium sulphate in cold water this substance crystallises out during the night, while the common salt deposits during the day, when most of the evaporation occurs. So if pans are scraped in the morning, the crop will consist of fairly pure magnesium sulphate, but after half is secured in this way, the liquid will require boiling during which most of the magnesium sulphate will separate and after cooling the sediment will be found to contain practically all the potassium chloride.

Prospects—The possible centres for the *bittern industry* are Bombay and Kharagoda in the Rann of Kutch (where the brine contains practically no potassium salts). A great obstacle to the development of the industry is the scarcity of fuel and often of fresh water in the immediate neighbourhood. The present prospect is summarised as follows:—

- (1) It should be possible to produce ample supplies of epsom salts at a price which should defeat all outside competition.
- (2) Magnesium chloride is available in quantities far more sufficient for present needs. Its manufacture has a good chance of becoming a commercial success.
- (3) The question of potassium salts and bromine deserves further investigation and the prospects cannot be foretold until economic conditions become settled. We shall have to provide against German competition and protect our industry from being killed by free imports.

4. Saltpetre.—Up to 1860 or a little later, India was the only country producing saltpetre, but the discovery of a method of making saltpetre artificially from the nitrate deposits of South America and the German potash beds hit the Indian trade very hard, so that exports had dropped from 35,000 tons in 1858 to 13,400 tons in 1913-14.

War and exports—Prior to the War India's principal customers were the United Kingdom and the United States (both demands steadily declining), China, Ceylon (demand steadily increasing), and Mauritius. After 1914, the output was diverted to the United Kingdom for munitions purposes. Steps were taken to increase the output already stimulated by a rise in prices. These were as follows :—

- (1) Reduction to Re. 1/- of the license fee for crude manufacture.
- (2) Issue of licenses through post offices.
- (3) Permission to compound for the duty on common salt educed in refineries.
- (4) Opening of areas hitherto prohibited on account of the relatively high proportion of salt contained in the earth.

The results of these measures can be judged from the following figures :—

Production of refined saltpetre.
(Thousands of maunds.)

Year.	Bihar.	U. P.	Punjab.	Total.
1913-14	1,85	1,70	87	4,42
1914-15	2,22	1,88	1,06	5,16
1915-16	2,19	2,36	1,52	6,07
1916-17	2,41	3,00	2,46	7,87
1917-18	2,30	2,59	1,56	6,45

The fall in production during 1917-18 was due to the abnormal rainfall during the manufacturing season.

Organisation—The manufacture of saltpetre is practically confined to Bihar, U. P., and the Punjab.

Preparation is by solution, concentration and subsequent refinement from earth containing nitrates which is the produce of bacterial action in the soil in and around villages, where a large quantity of nitrogen is derived from the excreta of men and animals and the decay of vegetable matter.

Nitrous sites are worked by men, known as *luniyas* on leases given by landowners. They have to take a license from the Government for the manufacture of crude saltpetre which contains from 30 to 50 per cent. of refined saltpetre.

The *luniya* has to pay the license money and the lease money for nitrous sites and has to sell the crude product to the refiner through a middleman by whom he is financed from start to finish. Under the terms of his license he is not allowed to carry the process further or to reduce any salt. This is true of Northern India except the Punjab, where the refiner himself takes out the license for the manufacture of crude saltpetre, employs his own servants on the work and defrays all the contingent expenses. Refiners have to pay a license fee of Rs. 50.

Uses and future prospects—Saltpetre is required not only for the manufacture of munitions and fireworks, but for use as manure, for the preservation of foods and the manufacture of glass. It is likely that the demand for these purposes will assume considerable importance. The first thing that is necessary is to systematize, improve and cheapen the processes of manufacture and then to increase the sources of production. The future of the industry is somewhat obscure because—

- (1) It depends on the degree to which restrictions on its manufacture imposed in the interests of salt revenue might be relaxed.
- (2) It is likely to be affected by the degree of importance that may be attached to the maintenance of a British Empire source of supply.

5. Coal Tar—The importance of coal tar industry in any complete scheme of chemical industries becomes evident when it is pointed out that this material contains upwards of 200 chemical compounds and is the source of the following organic chemicals :—

- (1) High explosives.
- (2) Aniline or synthetic dyes.
- (3) Synthetic drugs as contrasted with natural drugs derived from plants.
- (4) Photographic chemicals.
- (5) Synthetic flavouring or odoriferous materials *e. g.*, artificial musk and other scents and saccharine, that product which is 500 times sweeter than sugar.

Sources—The two sources of coal tar are gas works and coke ovens. An examination of coal tar from Indian coals proves them to be relatively poor in phenols. The amount of tar at present available is small. Therefore the only method by which the coal tar industry could be developed in India would be to coke at the pit-head all suitable coal and to send the tar and also oils, recovered from the oven gases, to a central refinery.

6. Alkaloids and other medicinal drugs—Alkaloids are basic substances from certain plant tissues and find their chief use in medicine. India is extremely rich in such plants. Up to this time only 2 plants, *viz.*, opium and cinchona have received attention. The following is the list of important alkaloids :—

- (1) Quinine—manufactured from cinchona bark. Supply still unable to meet the demand.
- (2) Morphine—the extraction of opium. Manufacture of morphine is now undertaken at the opium factory, Ghazipur.
- (3) Strychnine—prepared from *nuxvomica*. Recently attempts have been made to carry out extraction in India.

- (4) Caffeine—prepared from waste tea. Experiments are in progress at the Indian Institute of Science.
- (5) Nicotine—obtained from waste tobacco. It is of considerable value as insecticide.

The strain of War has led to a great development in the utilisation of Indian resources in the provision of drugs, medicines and other materials, not only to meet the requirements of hospitals in India, both military and civil, but also for overseas forces. In the Medical Stores Depots at Madras, Bombay and Lahore analytical chemists are now manufacturing many preparations from indigenous raw materials. The success attained has effected a considerable saving to the Government as the prices in the English market roughly advanced 400 % since 1914.

The subject of utilisation of indigenous resources for the manufacture of drugs has been under close investigation for several years both as regards obtaining supplies for present requirements and with a view to future developments.

The policy before the war was to buy in England, through the medium of the India Office not only manufactured drugs but raw materials for the manufacture of pharmaceutical products which had been exported from India, e. g.—

- (1) Sandalwood was exported and returned in the form of oil.
- (2) Myrobalans was exported and returned as tannic acid.
- (3) Nuxvomica beans were exported and returned as powder and extract and in the form of strychnine.
- (4) Ajwan seeds were exported and returned as thymol.

Now all these things are manufactured in India by private firms. Further, salts existing in India were never utilised, but now so far as medical requirements are concerned

potassium carbonate, bicarbonate, acetate, citrate, cyanide, red and yellow prussiate etc., are manufactured in India. In many things there are great *possibilities of a lucrative export trade* with England. If this is accomplished, the Empire will become self-supporting as regards a number of products formerly obtained from enemy countries. In order to do this a thorough survey as to the herbs and plants growing wild in Indian forests and Himalayas is imperative. If and when this is done, we shall know which plants grow, can be grown or can be grown most freely.

Of the medical preparations which were formerly imported, *32 kinds of preparations are now being manufactured and experiments are being made with the manufacture of others.* All pharmaceutical preparations such as tablets, pills, extracts, tinctures, liniments, liquors, unguents, powders etc., are now being prepared. Oxygen is compressed in cylinders for issue to hospitals. The Indian Institute of Science at Bangalore supplies ethyl chloride, calcium chloride, calcium lactate, sodium acetate, aniline oil and lactose. Oil of turpentine and rosin are supplied by the Forest Department and liquor ammonia fortis, lycopodium, acid sulphuric B. P., acid hydrochloric B. P., acid nitric B. P., and the various medicinal potash salts, by private firms in India which manufacture them.

Private firms are now exporting to Great Britain, America, and other countries Indian-grown drugs which these countries obtained from elsewhere. *The problem to be solved* is that of organising cultivation and collection. The question of reduction of railway freights has also to be considered. The high rail freights from the sources of supply to seaports and manufacturing centres within the country permitted Germany and other countries to send to London and India drugs at prices lower than those at which they could be available in India, e g, rail freights made it impossible for Indian-grown Bellodonna to compete with German Bellodonna.

7. Disinfectants and antiseptics.—India imports disinfectants to the tune of £ 60,000 annually. They are as follows:—

(a) *Permanganates*—*Sodium permanganate* is made from manganese dioxide which is obtainable in large quantities at a low price. The manufacture of *potassium permanganate* may offer some difficulty as potassium salts are not obtainable in India in sufficient quantities. The cost will also depend on the price of sulphuric acid which is required in their preparation.

(b) *Bleaching powder*—It is required for bleaching textiles and paper. Bleaching liquor has been prepared as a substitute, experiments being still made in Bombay to prepare a more stable bleach liquor. Bleaching powder is made by treating lime with chlorine. Its manufacture therefore depends on a cheap supply of chlorine. It is essential that it should be made within the country, as it does not keep well in hot climates.

When mixed with Boracic acid, it forms a disinfectant. *Boracic acid* is now made locally from borax imported from Tibet.

(c) *Chloramine T*.—It is a by-product in the manufacture of saccharine, the well known sugar substitute. It is a valuable disinfectant. Its manufacture is therefore dependent on the development of coal tar industry.

(d) *Formalin*—Obtained from the distillation of wood by the oxidation of methyl alcohol.

(e) *Carbolic acid*—The problem of the manufacture of carbolic acid disinfectants is complicated by the fact that Indian coal tars are extremely poor in acid constituents which are the basis of these disinfectants. They have been made since the outbreak of war, but the industry will probably not continue, if the coal tar industry does not develop on a large scale.

8. Fertilisers—Scientific agriculture requires replacing in the soil the mineral and other constituents removed by the crops, if the fertility of the soil is to be maintained. The mineral constituents essential for plant growth are potash, nitrogenous compounds, lime and phosphates.

One method of replacing these mineral constituents is by the supply of stable manure, but this is insufficient. So an industry of artificial fertilisers must develop in India,—as it has done in Europe and America,—as she is essentially an agricultural country and will remain so for a long time to come.

(a) *Potash*—chiefly in demand in jute-growing tracts. Supply can be met from the following Indian sources :—

1. Saltpetre.
2. A by-product in the manufacture of nitric acid, after neutralisation, gives an excellent potash fertiliser.
3. Dust from blast furnaces.
4. Dust of water hyacinth and cocoanut shells, after burning them as fuel.

(b) *Nitrogenous manures*—plenty in India in oil-cakes.

(c) *Lime*—there is abundance of it everywhere.

(d) *Phosphates*—the chief phosphatic fertilisers are :—

1. *Bones* in the form of bone-meal.
2. *Superphosphates* manufactured from bones or natural mineral phosphates and sulphuric acid.
3. *Basic slag* obtained from Iron and Steel Works.

Manufacture of bone-manure—The following products are obtainable in the manufacture of bone-manure :—

- (1) *Glue*—obtained by boiling bones with water, under pressure, after removing fats, the resulting liquor being clarified by evaporation.
- (2) *Size*—it is liquid or semi-solid glue.
- (3) *Gelatine*—it is a refined form of glue and is best obtained from sinews (or from bones from which the mineral matter has been separated by means of acids) by treatment with lime, washing, bleaching with sulphuric acid, steaming, clarifying and evaporating.

- (4) *Bone-meal*—obtained by grinding the residual bones after glue has been extracted. It consists mainly of phosphate of lime which may be sold direct as a manure or converted into super-phosphates by treatment with sulphuric acid.

India exports on an average bones to the value of about £ 280,000 and does not herself utilise this reserve of phosphatic material which she has in her bones. India thus loses a large amount of wealth which she can realise by their use as raw material (a) for the extraction of glue and gelatine, (b) for use as fertilisers, and (c) for the manufacture of bone black, buttons, handles etc.

Considerable quantities of artificial manures are imported into Beugal, Madras and Ceylon for tea and coffee plantations. Bone-meal can be used instead and in fact has been used by the planters.

Further, the Agricultural Departments have proved that in Northern India the application of this manure to the soil would have a very marked effect, since the available phosphates in large areas of the Gangetic Delta are almost entirely exhausted. If, therefore, it can be placed on the market in large quantities at a reasonable price, it is almost certain that the demand for it will, in time, become very great. The dominating factor in its production is sulphuric acid and if this becomes available at low rates, as it is likely, the finding of a local market for this product should greatly assist the development of *glue and gelatine manufacture in India*.

9 Salts—Various important industries require these metallic salts, e. g., in the textile industry, in dyeing and calico-printing we require sodium, zinc and iron salts; in the glass industry we stand in need of sodium salts; in soap manufacture sodium silicate; in match manufacture potassium salt in the form of potassium chlorate; in the manufacture of pigments, paints and varnishes zinc, lead and iron salts, and in the tanning industry aluminium, chromium and iron salts; while zinc salts are required for preserving wood, for use as soldering solutions, disinfectants and medicines;

Lead chromate is a yellow pigment, largely used in calico-printing. India exported in 1917-18 chrome iron ore to the value of over £32,000 and imported salts to the extent of over £54,000.

(k) *Iron salts*—The only iron salts manufactured in India is *ferrous sulphate* or *green copperas*, prepared on a large scale, by treating scrap-iron with dilute sulphuric acid. Largely used in dyeing, tanning and manufacture of inks, Prussian blue and other pigments. Production developed since the outbreak of war. Success of the industry will depend on the supply of cheap sulphuric acid. The present output is approximately 1,000 tons per annum.

10. Minor products—These are useful in the mining, dyeing, and tanning industries, in the manufacture of varnishes and as medicines.

(a) *Cyanides and Ferro-cyanides*—Goldmining depends on an adequate supply of sodium or potassium cyanide. If gas works are developed, ferro-cyanide will be obtained very cheap as a by-product. It is mainly used in the manufacture of pigments such as Prussian blue. On a small scale, it is manufactured by an old method from horns and old organic matter, but yields are poor and cost high.

(b) *Acetic acid and Acetates*—As the number of wood distillation factories increases, the supply of these at a low price will increase. Numerous experiments have been made in recent years and a large number of patents taken. The products are used mainly in the dyeing industry and as medicines.

(c) *Methyl alcohol*—Known also as wood-spirit, one of the by-products of wood-distillation factories. One of its chief uses is as a solvent, more particularly in the manufacture of spirit varnishes.

(d) *Oxalic and Formalic Acids*—Manufactured on a large scale by fusing saw dust with caustic soda. Development depends on a cheap supply of caustic soda and caustic

potash. Used mainly in the dyeing industries, for medicinal purposes, and in tanning.

(e) *Citric acid*—Manufactured from the juice of lime in Sicily and America. In India manufacture possible. Cheap supply of sulphuric acid is a requisite for success.

(f) *Tartaric acid*—Manufactured in Europe as a by-product in the manufacture of wines by the fermentation of grape-juice. Used medicinally as well as in the manufacture of baking powders, effervescent drinks and in dye-works.

A possible source in India is pulp of tamarind fruit which contains 12% of tartaric acid. Small quantities have been prepared from this source. But its manufacture in larger quantities is practicable, only if pulp could be obtained at an extremely low price such as Re. 1/- to Rs. 1/5 per cwt., at which price tamarinds can be bought at Indore. There its production is therefore practicable.

Chapter 8.—Metallurgical Industries.

Metallurgy, a very ancient art—Metallurgy is one of the very oldest arts dating back to the successful attempts of primitive man to replace stone implements and weapons by those of metals. Chemistry, on the other hand, is a science, developed historically from the researches of alchemists for the 'Elixir of life' and the 'philosopher's stone.' With the progress of modern research, metallurgy is rapidly passing from an art into a science. Still it may legitimately be regarded as a branch of applied chemistry.

Condition in India—The development of metallurgical industries depends, to a large extent, upon the existence of suitable raw materials, but the value of these is relative to external circumstances. Many of the deposits of metallic ores in India are generally poor, but so long as foreign competition did not begin, she was able to supply very nearly all the requirements of a very highly civilised community from within her own borders. The price paid was very

high but still the artisans could secure but a scanty subsistence—so much hard work and enormous amount of labour were required.

Now, the trades of the indigenous miner and smelter, except in case of iron, have been almost completely crushed out of existence by the competition of imported products produced by modern methods abroad. The indigenous iron industry which is carried on to this day in a struggling condition in numerous diminutive blast furnaces produces by wasteful methods small blooms of soft iron, used chiefly for making axe-heads, ploughshares and such other things.

A study of the various workings existent in many parts of the Indian Empire shows that several metals were won from the hard rocks which were crushed and smelted, e. g .

- (1) The old working of gold quartz reef in Mysore on which the modern gold industry of the Kolar Field is established.
- (2) The old copper working in Singhbhum which is now worked by the Cape Copper Company.
- (3) The mining and smelting of silver-lead ores, for silver, by the Chinese in the Northern Shan States, now succeeded, after a lapse of some 50 years by the developments of the Burma Mines, Limited, with its discoveries of large stores of rich silver-zinc-lead ores and silver-copper ores.
- (4) Stream tin deposits of Tavoy seem to have been washed and smelted for centuries.

Production and progress — By the beginning of the present century the only metallurgical concerns successfully established in India on modern lines were goldmining of the Kolar Field and the Barakar Iron Works. *During the present century, metallurgy in India has taken a sudden step forward as is shown by the production of metals in India by the following table : —*

Production of metals in India.

Year.	Gold 1000 ozs.	Platinum ozs.	Silver 1000 ozs.	Lead 1000 Tons.	Tin metal Tons.	Tin Ore Tons.	Pig iron 1000 Tons.	Steel 1000 Tons.	Ferro- manganese 1000 Tons.
1901	332	...	...	...	...	82	35	...	...
1905	631	...	4,000	91 ²	...	76	45	...	...
1908	568	...	...	...	...	95	38	...	...
1909	575	...	27	5	...	84	39	...	...
1910	573	...	49	12	75	89	36	...	...
1911	583	377	104	13	88	97	49	...	...
1912	590	666	93	8	201	175	146	...	...
1913	596	577	125	6	182	141	204	63	...
1914	607	367	236	10	98	270	235	66	...
1915	617	177	285	13	128	431	242	76	26
1916	598	92	760	13	113	650	245	93	18
1917	574	38	1582	17	141	666	248	114	15
1918	...	...	1396	13	...	...	...	...	11

- Notes:--
1. Production of Silver in 1918, given up to August.
 2. Production of *copper*, commenced August 1918.
 3. Lead is also produced in small quantities in—
 - (a) The Southern States,
 - (b) The Central Provinces,
 - (c) Kashmir, and
 - (d) Mysore.

Progress of mining during the present century.

(1) In 1903, gold mines in the Hyderabad State began working.

(2) In 1907, the Tata Iron and Steel Company was registered.

(3) In 1909, after several years of preliminary work, the Burma Mines, Limited, commenced smelting old Chinese slags for lead and silver.

(4) In 1911, in December the first pig-iron was produced at Sakchi, now better known as Jamshedpur.

(5) In 1912, steel was produced at Sakchi.

(6) In 1915, ferro-manganese was first manufactured by the Tata Iron and Steel Company.

(7) In 1917, the Cape Copper Company, after several years of development work, produced a small quantity of copper.

(8) In 1918, regular production of copper was started as well as the Bengal Iron and Steel Company, at the instance of the Indian Munitions Board, turned to the manufacture of ferro-manganese so as to release one of the large Tata blast furnaces for the production of pig-iron.

From the above it is clear that the last decade, 1909-18, has seen the initiation of production in India, on a commercial scale of lead, silver, copper and ferro-manganese. The future offers many further possibilities. Our raw materials would permit of a large increase in the production of ferro-manganese and, once cheap electricity becomes available, of the manufacture of other ferro-alloys as well as aluminium and calcium carbide.

Exports of metals from India—Figures given in tons.

Year.	Brass and Bronze etc.	Copper.	Iron & Steel. (000's omit- ted.)	Lead. (000's omit- ted.)	Tin.	Tin Ore.	Zinc and Zinc Ore.
1912-13	151	206	104.2	7.5	13	214	120
1913-14	127	241	94.8	3.5	47	210	7,660
1914-15	94	190	52.8	6.5	21	115	4,910
1915-16	91	50	72.6	10.8	5	87	187
1916-17	226	790	115.4	10.4	1	214	3,210
1917-18	17	122	52.6	10.6	4 cwt.	300	2

NOTE.—Figures of Imports and Exports do not include gold and silver as these are precious metals. Their importance lies not so much in their use in industries as in currency and other ways.

Imports of Metals into India—Figures in thousands of tons.

Year.	Tin.	Aluminium	Brass and Bronze.	Copper.	German Silver.	Iron and Steel.	Lead.	Quick silver.	Solder.	Zinc.
1912-13	1.6	1.7	17	6	.8	729	5.7	.1	.2	5.5
1913-14	2.1	1.3	21	17	1.3	1000	6.2	.09	.3	6.7
1914-15	1.9	.7	14	12	.6	609	4.6	.04	.3	2.2
1915-16	1.4	.7	3	4	.1	425	5.8	.03	.3	.8
1916-17	1.4	.04	3	1	.03	257	4.7	.05	.2	1.4
1917-18	1.2	.03	2	2	.01	152	4.4	.07	.1	3.5

Note.—It will be seen from the statistics of imports and exports that India does not yet produce all the metals required for internal consumption, but from what is going to be said hereafter, it will seem likely that she will do so in the near future.

Essentials of modern metallurgy—In addition to ores of sufficient richness, we require many other things before successful production of metals in any country is undertaken. Leaving out of account such factors as market conditions and transport, modern metallurgy needs—

1. *Reducing agents*—usually coal, coke, charcoal or electricity—some source of heat to produce the temperature necessary to permit reduction.

2. *Fluxes*—limestone, dolomite, iron-ore, siliceous materials, and flourspar, — to combine with and remove in the form of slags impurities of ores and to impart the fluidity requisite for successful operation.

3. *Refractory materials*—sand, fireclay, magnesite, dolomite, chromite, bauxite and graphite — for lining furnaces and constructing retorts and crucibles, capable of withstanding high temperatures and the corrosive action of materials smelted.

4. *Carbon electrodes*—for electric smelting processes or dry metallurgical practice with which the future of metallurgy in India lies. The possibility of this in India requires special consideration, as ores exist in India remote from coal fields.

Prospects.

India has vast resources of *water power* in the Western Ghats, Assam plateau, the Nilgiri Hills, the C. P., and Burma to convert it into *electric energy*. If sufficiently cheap electric energy becomes available, we may expect one day to see the electric treatment in India of the iron-ores of Mysore, Goa, Ratnagiri, the manganese of the Sandur Hills, the bauxites of the Western Ghats, C. P., and Chotanagpur, the wolfram of Tavoy, the chromite of Mysore and finally the copper ores of Sikkim.

In the manufacture of *carbon electrodes* the chief ingredient is pitch of which Indian coal tar contains a high percentage. The manufacture is bound up with the installation of tar-distilling plants on a considerable scale.

Refractory materials are found in abundance at various places. Silica-bricks and fire-bricks are already being manufactured in Calcutta, superior in quality to imported ones. Tatas get these materials from Mysore. Singhbhum also contains many varieties of such materials.

India possesses a vast store of *fluxes* in many geological formations at various localities.

Indian *coals* are not generally suitable for the preparation of good coke. Indian coke is typically high in phosphorus and ash contents. The phosphorus contents of most manganese ores are also high. This makes it exceedingly difficult to produce ferro-manganese in India with phosphorus not greater than 0.3%, the upper limit usually accepted in Europe. With electric smelting and charcoal fuel and careful selection of ores this figure could however be realised.

So the *main difficulty at present* is the provision of a coke sufficiently low in phosphorus and ash contents.

Good coke is also required in lead and copper smelting.

In zinc distillation and in reverberatory furnaces where the gaseous products only come in contact with ores, impurities of coal do not affect the quality of the product.

The future development of metallurgical practice may, in certain cases, lead to the use of oil fuel and then India's needs should be amply supplied from Burma and the Punjab, but as has been remarked above, the future lies with dry metallurgical practice in electric smelting.

Prospects for metals in India—

(1) *Aluminium*—prospect favourable, if cheap electric energy is provided.

(2) *Antimony*—Only small quantities extracted in India. Fair field in Burma. Its *industrial uses* are :—

a. Hardening alloys.

- b. Its sulphide is required in match industry and vulcanising rubber.
- c. Its tartrate and oxalate is used in calico-dyeing and printing.

(3) *Copper and Brass*--Its annual consumption in India is from 25,000 to 30,000 tons. Singhbhum is the copper-mining area in India. Production by the Cape Copper Company, Limited, will be very soon 1000--2000 tons annually. With the establishment of zinc-smelting, production of brass will become possible.

(4) *Ferro-manganese and other ferro-alloys*--There are in India numerous deposits of manganese ores, chrome ores and wolfram. Development of the industry depends on the supply of cheap electric energy. Meanwhile the production of ferro-manganese by the customary blast-furnace methods has already been successfully inaugurated.

(5) *Gold*--From time immemorial river gravels in India have been washed for gold. Small quantities are recovered in this way, not exceeding a few hundred ounces annually. Upper reaches of Irawadi have been drained for gold by the Burma Gold Drndging Company. In 1917, 1006 oz. were obtained, but the operations have now been discontinued.

Kolar Gold Field had been worked in bygone days. Modern operations began in 1881-82. Success attained in 1885. The deepest working is now some 4,000 ft. below the surface. The Kolar Field contains some of the deepest mines in the world. Production averages 600,000 ounces, worth £2,300,000. In 36 years, since the commencement of work under European supervision, these mines have yielded gold to the value of £49,000,000 (1917).

(6) *Iron and Steel*.--The first attempt to manufacture iron and steel on modern lines was made at Porto Novo in South Arcot in 1830. All during the 19th century several attempts led to conspicuous failures.

In 1875 *Batakar Iron Works* was established. In 1889, it became *the Bengal Iron and Steel Company*, but it was not till 1899 that a profit was made. The annual production then was 35,000 tons. *Attempts to produce steel in 1905 and 1906 failed owing to—*

1. the low price of imported steel at the time,
2. orders for small quantities of numerous sections instead of large orders for a few sections of steel,
3. inferior quantity of pig iron then produced, and
4. the necessity then existing of importing all fire-bricks and ferro-manganese.

From 1910, commenced a new era in the history of the company, when iron-ore supplies from Singhbhum began to arrive. The pig-iron produced is partly consumed in the company's foundaries, partly marketted in India, and partly exported to Japan, Australia, and South Africa. The coke-ovens are fitted with plant for the recovery of the by-products, e. g., tar and ammonia which is converted into the fertiliser, ammonium sulphate, the yield of which is about 95 tons monthly. Sulphuric acid is also made in the Works, the yield being 5 tons daily.

The Tata Iron and Steel Company was registered in 1907 and started work in 1911. It has proved very valuable to the prosecution of the war by providing large quantities of rails and sleepers for military railways in Mesopotamia, Palestine, East Africa and Salonica.

Distribution of Steel from Sakchi.

In 1916-17, 50,000 tons for Indian Railways, out of this 21,000 „ to meet the requirements of forces in Egypt and Mesopotamia.

In 1917-18, 97,000 of which 71,000 tons of rails and fish-plates and 4,200 tons of other sections were for overseas.

In 1918-19 (April-September), 55,000 out of which 16,000 tons of rails and fishplates and 1900 tons of other sections were for overseas.

Over and above this, a considerable tonnage of steel sections were supplied to engineering firms in India for the fabrication of river crafts, workshops, and other steel structures for the various forces.

The discovery of iron-ore in Singhbhum is *epoch-making* in the history of Iron and Steel Industry in India, future developements in which ought to be concentrated in or near Singhbhum which must become a second metallurgical centre in India.

(7) *Lead*—The source is lead-silver mines in Bawdwin in the Northern Shan States. In 1902, to work it, the Great Eastern Mining Company was formed, but it was eventually sold to the Burma Mines, Limited. In 1909, first production of lead and silver took place. Ores contain—

lead	...	26·8 %
zinc	...	18·7 %
copper	...	0·7 %
silver	...	24·2 ozs.

per ton. When present extensions are completed, the annual production will be—

Lead	...	31,500 tons.
Silver	...	24,75,000 ounces.
Zinc concentrates		25,000 tons.

In 1916, India became self-supporting in respect of *lead*.

(8) *Nickel*—Adequate supplies of ores not yet located in India. A small quantity may be forthcoming from the smelting of the Bawdwin ores. Its uses are:—

1. For currency purposes.
2. For preparation of German Silver
3. For munitions purposes.

(9) *Platinum*—A very small quantity recovered from the Irawadi gravels by the Burma Gold Drudging Company, which has ceased work.

(10) *Silver*—Net annual imports during 1904-08 were 94,000,000 ounces or about $73\frac{1}{2}$ thousand maunds and during 1908-13 over 81,000,000 ounces or about $63\frac{1}{2}$ thousand maunds.

Annual yield from Bawdwin mines promises to be over 2,000,000 ounces. Proposed extensions at Namtu will yield 7,000,000 ounces annually.

(11) *Tin*—India's neighbour, the Federated Malay States produce some 43 % of the world's output of this metal.

With the proposed installation of mills for rolling steel-plates at Jamshedpur, the production of tinplate in India seems to be a probability of the near future.

(12) *Zinc*—Hitherto India has altogether depended on foreign supplies. It is now proposed to erect at Jamshedpur plant for smelting, in India, of zinc sulphide concentrates of Bawdwin. It will then be possible to produce galvanised iron-sheets in India. 32,000 tons of sulphuric acid will be produced, per annum, as a by-product and it will be of great value in promoting the development of chemical industries in India.

Chapter 4.—Oil Industries.

India's position—The position of India as regards the production of raw materials for oils is supreme. The chief oilseeds produced in India are linseed, cottonseed, coconut, rape, groundnut, castor, sesamum and mahua. Oils are used for the manufacture of soaps, for culinary and lubricating purposes, as illuminants, in medicine and for making smokeless powder and explosives. Considered from this point of view oilseeds and oils occupy a very important position in the industrial life of the country.

Exports—In the past the Indian trade has been mainly in the raw material. Exports of oilseeds, oils and cakes are given as follows:—

(FIGURES IN MILLIONS.)

Year.	Oilseeds.	Oils.	Oilcakes.
	£	£	£
1912-13	15	·57	·82
1913-14	17	·65	·92
1914-15	9·66	·70	·70
1915-16	6·58	·81	·75
1916-17	10·77	1·00	·66
1917-18	5·00	1·32	·47

The problem—With a few exceptions the oil-pressing industry is run in India on mediæval lines. The oil produced is highly coloured and impure and fetches a comparatively low price in the market. The problem of improving the industry requires careful consideration as it is complicated with the following facts:—

(1) The raw materials are admitted duty free into most countries, whereas a tariff duty is imposed on the finished products, oils and oilcakes.

(2) The freight on seeds is comparatively low, as they are carried in bulk, whereas the freight on oil and even cakes is relatively high. The question of the use of tank steamers similar to those used for mineral oils is worth consideration.

(3) A large proportion of the oilseeds exported before 1914 went to Marseilles and the oils were extracted in southern France, while normally only about 25 % of the total imports of oilseeds into France were derived from French colonies. Now that the pressing and extraction of oils is receiving attention in England, it is realised in France that most of the exports of oilseeds from the British Empire will be directed in future to England. As a result of this the French Government is striving to encourage the growth of groundnuts in French West Africa, of castor in Indo-

China and Madagascar, of linseed in Tunis, and of cotton in several of the French colonies. America has also increased the acreage of land under groundnuts, has undertaken the growth of soyabean and is planting 2,00,000 acres of land with Indian castor seeds. Castor is also being cultivated in Brazil and West Indies. All these activities indicate an appreciable increase in the world's supplies of vegetable oils which should be met with increased demands, if prices are not to fall.

(4) A large proportion of oil manufactured in India is characterised by its high acid value which indicates a decomposition of the oil into fatty acids and glycerine, due to the non-destruction of enzymatic ferments present in the seed. This renders them unsuited for many industrial purposes. So long as Indian oils are liable to this defect, they will not find favour in foreign markets.

(5) *The best method to remedy these defects is to introduce modern plant, but small capital required by country methods is an advantage which should not be altogether ignored.*

(6) The methods of disposal of resulting cakes require careful consideration.

Directions of Expansion—The development of the oilseed industry requires to be directed and encouraged along the following lines :—

1. Extraction of oil by the solvent process in order to yield better quantities without extracting deleterious substances.
2. Treatment of the cake so as to make it a high grade cattle food.
3. Refining of oils by methods which cause the least possible loss and will produce the highest grades of edible oils, tasteless and odourless, both liquid and solid.

4. Utilisation of the by-products of refining in order to recover fatty acids and the transformation of the latter into finest soaps and other useful merchandises.
5. Treatment of recovered fibres for use in explosives or artificial silk manufacture or other types of profitable merchandises.
6. Manufacture of pure vegetable substitutes for *ghee*, more or less of the nature of European or American margarines in view of the growing scarcity of *ghee* in India.

Oilseeds and oils, their uses etc.—

(1) *Linseed*—Linseed oil owes its importance mainly to its use in the manufacture of paints and varnishes for which purpose the oil has hardly a competitor. This is due to its valuable property of hardening and drying when exposed to the air, especially in the presence of driers.

(2) *Cotton seed*—If all the seed available were worked for oil, some 2,00,000 tons of oil would be produced; but in India, at present, much of the seed is fed direct to cattle as food.

In pressing oil it is necessary that the seeds should be pressed as soon as possible after ginning, as they rapidly deteriorate owing to lint retaining moisture which ferments bacteria.

The oil obtained from Indian cottonseeds is not, as a rule, of the same high quality as that from Egyptian or American seeds and therefore costs of refining are greater. The oil content of Indian seeds is somewhat low, being about 18 % in comparison to 23 % of the American.

The high grade oil is used in Europe and America as an edible oil in place of olive oil and also in the manufacture of butter substitutes, whilst lower grades are used for the manufacture of soaps.

(3) *Rape seed*—Rapeseed is widely grown in all European countries but *India is its largest centre in the world*. The seeds contain from 42 to 45 % of oil. It is used mainly for—

- a. Edible purposes.
- b. Anointing the body.
- c. Illuminating purposes.
- d. Making soaps.
- e. Making lubricants.

The cake forms an excellent cattle food.

(4) *Sesamum*—Sesamum is grown mainly in India, although it is cultivated to some extent in Java, China, Japan, Africa and South America. Seeds give 44 % of oil. Main uses—

- a. Culinary purposes.
- b. Anointing the body.
- c. An essential constituent of all artificial butters, The presence of this oil is required by law in certain European countries. Hence exports of seeds are considerable.
- d. Soap manufacture—lower qualities.
- e. Lubrication,
- f. Cake—a valuable cattle food.

(5) *Groundnut*—Widely grown throughout the world. In India mainly in Madras, Bombay and Burma.

- a. Pure oils used for edible purposes.
- b. Less pure for making soaps and lubricants.
- c. Cake used for mixing with wheat flour for human consumption—nutramine.

(6) *Castor*—Castor oil has become of enhanced importance owing to its use as lubricant in aeroengines. *India is the main source of its supply.*

The oil by cold expression is used as a high grade lubricant and for medicinal purposes, the lower qualities for the manufacture of adhesive gums.

When treated with sulphuric acid it yields Turkey red oil, largely used in dyeing and finishing leather.

‡ The cake is an excellent fertiliser. It is valueless as cattle food.

(7) *Cocoanut*—Cocoanut is a factor of great economic importance on the Western Coast of India. Every part of this tree plays an important part in the domestic life of the people, a large proportion of whom depend for their livelihood on the cocoanut, *e. g.*,

- a. Its leaves are used for hutting and roofing and for the manufacture of brooms, baskets and umbrellas, or are burnt for manure.
- b. Its shells are used for fuel. The dust gives a good potash manure.
- c. Its juice is drunk, fermented or unfermented, is made into jaggery and distilled into arack.
- d. Its nuts are eaten.
- e. Its oil is used for lighting, cooking and soap-making.
- f. Its trunk is employed either in building or used as waterpipes.
- g. Its coir is used in the form of yarn, matting or rope. Coir-yarn is to some extent the currency of the coast, being exchanged for household necessaries.

* In recent years most of the available *copra* on the West coast has been exported either in the form of copra or oil. In 1917 large quantities of copra were imported from Ceylon to supplement west coast supplies. British Cochin is its great market.

The industry is in the hands of small Indian cultivators. No attention has yet been paid to its improvement. In the Straits Settlement 4,000 nuts are said to produce one ton of copra, while in India 7,000 are required to produce the same quantity. The Madras Agricultural Department has now taken up the matter.

The oil is mainly used for the manufacture of edible oils and fats. 70 % of the export trade in nuts and oil was with Germany. Now France has taken the place of Germany.

Oil from sun-dried nuts is of superior quality than when nuts are dried in kilns. Malabar Copra yields 68 %, Ceylon, 65 % and Manila 59 % of oil. Cake is valuable both as cattle food and as manure.

A large copra-crushing mill is soon going to be established near British Cochin by the Tata Oils Company, Limited.

The Government Soap Factory at Calicut has successfully used cocoanut oil for the manufacture of Soap by the cold process and now that the war has ended, there will be a large development of soapmaking on the western coast.

A new use for charcoal made from cocoanut shells has been found since the war began. It absorbs gases to an extraordinary degree and was being made on a large scale near Cochin for use in anti-gas-respirators.

Cocoanut shell, if carbonised slowly at low temperatures, is exceptionally rich in acetic acid. The ash is extraordinarily rich in potash and makes a valuable manure:

Coir is another great branch of the cocoanut industry. Exports of coir, in 1913-14, amounted to over a crore of rupees. The industry is entirely a cottage one. The husks are buried in pits on the banks of rivers and backwaters and after 8 or 9 months are taken out and beaten by women into fine fibre. The best yarn is produced where the rise and fall of the tide is most marked, the reason being that tides wash away the accumulation of gases. The manufacture of thick roping yarn and matting is an important

industry at Allepy and Cochin. Coir mesh bags and coir ropes and cordage form another important branch of manufacture. Hundreds of tons of yarn and thousands of yards of matting have been supplied to the army in Mesopotamia and India and 150,000 square yards of coir-screening have been supplied every month to Army Head-quarters in France for camouflage purposes.

(8) *Mahua seed*—It is largely used in India as an edible oil. Mainly exported to France prior to the war. Its cake is an excellent fertiliser. It is also used as a substitute for tallow.

Essential Oils—*The East is regarded as the source of the most important scents and spices.* In India occur many of the raw materials from which scents are manufactured. Exports of such raw materials amount on an average to £ 420,000.

Some of the raw materials such as cardamom, sandalwood, ajwan, palmorasa are grown only in India and Ceylon.

Before 1914 the only oils actually manufactured in appreciable quantities and exported were lemongrass, palmarosa, gingergrass and citronella. In practically all other cases raw materials were exported. Probably the only reason why the above-mentioned oils were distilled in the country was that they were obtained from grasses, freight charges on which were relatively high. Since 1914 various developments have taken place in the distillation of essential oils. *In order to improve the yields and qualities it is necessary to adopt the following hints:—*

1. Suitable cultivation of plants known to give essential oils.
2. Better distillation.
3. Best method of isolating the oils and the use of the best type of plant.
4. Scientific refining of oils.

Prospect of essential oils.—

(1) *Sandalwood oil*—The Mysore Government has stopped the export of sandalwood and now practically distills all the wood in her own factories.

(2) *Thymol*—Several firms have taken up its manufacture from *ajwan* seeds. *In pre-war times India was the only country where ajwan was grown.* Now in Spain as well as in America something like it has been grown.

(3) *Lemongrass oil*—A firm in Cochin is erecting special stills for refining it.

(4) *Oitnorella oil*—Its chief source used to be Mysore. Now it is being distilled in Burma and exported.

(5) *Palmarosa oil*—Yield will increase greatly by substituting steam-distillation.

(6) *Cardamom oil*—Attempts have been made to develop its distillation.

Chapter 5.—The Paint and Allied Industries.

Present position—The manufacture of paint, varnish and painter's materials forms an important group of industries. Some of these are entirely unrepresented in India, some are in a more or less experimental stage, while others are well established. None has, however, reached the development that the country's resources justify and that may be anticipated in future.

Imports of paints and painter's materials.—Annual imports amount on the average to £ 600,000.

<i>Year.</i>		<i>Value.</i>
		£
1913-14	... ..	549,000
1914-15	... ..	503,000
1915-16	... ..	541,000
1916-17	... ..	765,000
1917-18	... ..	645,000

Materials used in paints—Materials used in paints are

(1) *Oil*—mostly linseed which, when exposed to the air in thin films, forms an elastic coating.

(2) *Pigments*—which are finely divided solids, such as red oxide and china clay which reinforcing the oil forms a valuable and decorative covering.

(3) *Thinners*—which are volatile liquids such as turpentine to dilute the mixture of linseed oil or pigments which is usually too thick for application.

Varnish—A varnish contains no pigments and the necessary strengthening of the film is attained by mixing hard resins. A varnish is thus not only transparent but hard and lustrous.

Oil—Indian linseed oil is of good quality and better than the imported one. The oil is used as "raw," "refined," and "boiled." *Refined oil* is a partially bleached oil, used in white paint, usually prepared by treating raw oil with sulphuric acid.

Boiled oil is prepared by heating raw or refined oil with "driers," which are usually lead and manganese compounds, whereby it becomes not only much more rapid in drying but gives a harder film. The only difficulty in having as much raw oil as required is to dispose of cake which is 70% of the seed.

Turpentine—This is obtained by the distillation of the resinous substance exuded by certain kinds of pine, the residue being *rosin*. The turpentine industry of India is of quite recent origin, but it has made rapid strides in the last few years. Imports of these American products have been greatly reduced since the war began, as the following figures, contrasting the imports with the Indian output, will show:—

(Figures in thousands.)

Year.	Rosin (maunds.)		Turpentine (gallons.)	
	Imports.	Indian output.	Imports.	Indian output
1913—14	62	27	193	58
1914—15	34	33	142	79
1915—16	43	47	86	111
1916—17	25	59	80	125
1917—18	44	60	140	136

The unexploited resources of turpentine are considerable. The ultimate production may be estimated at 600,000 maunds of rosin and 16,00,000 gallons of turpentine. As production in other countries is not expected to keep pace with demand, with such an output at its command, India could become an exporting country and probably meet the demands of Africa, the Straits, China, Java and Australasia, in addition to her own.

The indigenous products have been pronounced and found to be superior to imported ones. The industry has a great future before it. Modern methods have standardised the Indian products. In addition to their use in varnish and paints,—without which Railways and other large paint-consuming concerns would have had great difficulty,—rosin is required for filling shrapnel shell, forms an important constituent in paper and soap making and in the form of Rosin oil,—the product of distillation of rosin,—is the main ingredient of a class of largely used lubricating greases.

Production is carried on by the Forest Department at Bhowali, U. P., and Jallo, Punjab. A new factory is under construction at Bareilly.

Petroleum substitutes for turpentine are used in making ordinary paints, but in the manufacture of varnish real turpentine is necessary.

Pigments.—The *natural pigments* found in India are barytes, ochres, and certain kinds of red oxide, also a few minerals such as china clay, which are occasionally used as paints and gypsum, the use of which is undesirable rather than uncommon.

Barytes, the natural form of barium sulphate, is a white transparent substance. It is used in white paints as well as in many coloured ones. It occurs in India in the Madras Presidency, Rajputana, Chotanagpur and the Central Provinces.

Yellow and red *ochres* of good quality are found in the Katni District.

Indian *red oxides* are poor in colour. The best is imported from the Persian Gulf, until an artificial one is produced as a by-product of several industries.

To utilise present resources more machinery and skilled labour is required, because natural deposits are hard to grind to the necessary degree of fineness.

Artificial Pigments.—The most important of the artificial pigments is *white lead* which has not, so far, been manufactured in India, but *red lead* is already being manufactured and its quality is better than that of the imported. Its manufacture requires only metallic lead which can be had from Burma. Another *lead pigment* which has proved very successful in America is “sublimed white lead,” prepared from galena (natural lead sulphide). The manufacture of *zinc white* and other zinc pigments appears feasible as the refining of zinc concentrates from Burma is likely to be developed in the near future.

The various *lead chromes*, such as chromium oxide green, are also being made by the help of imported chemicals, for the present.

Lampblack may shortly be made in India.

Prospects of manufacture in India.—Indian products include all that is necessary for the manufacture of ordinary paints, while mineral resources and established manufactures provide all the pigments necessary for some paints and a large proportion of pigments of some others. If *white lead* can be manufactured, as there is prospect of it, India can become independent of imported materials and save a crore of rupees being paid for as their price. Under war conditions, the best Indian-made paint has shown a marked superiority over the imported and this is largely due to her exceptionally favourable position as regards linseed oil.

Copal Varnish, is the most important kind. Copal is a general term for hard varnish-making resins. The best comes from Africa. Most of the varnish sold in India is made from copal imported from Singapore. Varnish usually contains about 20 % Copal, linseed oil, turpentine and turpentine substitutes. *The position of India as regards the supply of materials is exceptionally favourable.*

Spirit varnishes are made from shellac and India is a principal shellac producing country.

Lacquers are also varieties of shellac varnish and can be made in India, though usually imported.

Chapter 6.—Forest Industries.

Importance of Forests.—Indian forests form an important asset of natural resources and play by no means a small part in the economy and commerce of the country. They are an important source of revenue to the Government. The annual gross income is well over 4 crores of rupees now. The net revenue to the State will be, on an average, about 2 crores of rupees and it is bound to grow as we employ a more sane and reasonable method of economic exploitation of forest products. Exports of forest products even now average to over 4 crores of rupees in value at port of shipment.

Forest products—The most important forest product is *wood and timber*. The number of tree species is about 2,500 while the number of woody shrubs and climbers is not far short of that total. The following are the *important species of timber* :—

1. Teak—first both in quality as well as the amount exported.
2. Sal—next in importance.
3. Deodar—extensively used in construction and as railway sleepers.
4. Sandalwood—source of sandalwood oil.
5. Sissoo and blackwood—highly prized for building purposes and furniture making.
6. The Sundri wood of the Sunderbans—used in boat and carriage building.
7. Padmak of Andamans and Burma—used for the construction of gun-carriages, furniture and railway carriages.
8. Pyinkado of Burma—used in building and one of the first sleeper woods in the world.

Turning to what are classed as *Minor Forest Products*, the most important come under the following main heads :—

1. Fibres and flosses—munj and simul floss.
2. Glasses—sabah, bhabar and baib.
3. Distillation products—rosha and lemon oils.
4. Oilseeds—mahva, sandalwood and agar wood oil.
5. Tan and Dyes—myrobolams and Cutch and Kamella powder.
6. Gums and resin—lac.
7. Rubber and other exuded products such as babul gum, gurjan oil.

8. Drugs and spices—cardamoms, pepper and strychnine.
9. Edible products.
10. Bamboos and canes.
11. Animal and miscellaneous products.

Their number is very large. Some of them are of considerable economic importance. The total revenue derived from Minor Products is over 125 lakhs of rupees.

Development of Forest resources—The development of the economic resources of the Indian Forests has not yet received the attention it deserves and which it is bound to receive in the near future. The general backwardness in the past in the commercial development of forest resources has had two unfortunate indirect results, *viz.*,

- (1) that measures have never been taken till recently to discover the best methods of seasoning Indian timbers, and
- (2) that the value of timber of most of the species and their properties have not become known to Indians themselves.

The result of the combined operation of these two causes has been a general preference to the imported article and the uneconomical use, as well as the use in an unseasoned condition of the Indian timbers.

Prior to the creation of the Indian Munitions Board, roughly 66 % of the timber supplied to the military forces in the eastern sphere was of foreign origin. After that 95 % of the timber purchased by the Board was grown in India and Burma. The advantages of this course have been as follows :—

- (a) Stimulation of the economic exploitation of forests.
- (b) Bringing to notice many species of timber hitherto little known.

- (c) Securing the profits arising from the sale and handling of the material.
- (d) Keeping supply price low inspite of largely increased consumption and unprecedented volume exported.

Forest Industries—Forest Industries may be classified in some such way as this—

- (1) Sawing industry.
- (2) Seasoning the timber.
- (3) Antiseptic treatment of timber.
- (4) Pine resin industry.
- (5) Collection of raw materials for paper manufacture and turning them into pulp at the source of supply.
- (6) Match-splint industry.
- (7) Lac Industry.
- (8) Collection of tan and other stuffs, such as catch industry.

Sawing—As regards sawing facilities, Burma with its enormous forest resources is far ahead of India Proper, possessing more sawing mills than the whole of the rest of India, where expansion, under War stimulus, has been hampered owing to the extreme difficulty of obtaining machinery from abroad. In spite of this a few additional mills have sprung up in Bombay and other places. These developments have however been mere transfers of existing plant from places where it was not working remuneratively to places where it could be so worked.

Seasoning—As regards the proper seasoning of Indian timbers a notable advance has already been made. In Europe and America artificial methods of seasoning are in use with success. Their chief merit lies in the saving of time and capital outlay. Experiments are in progress, but unless and until such artificial methods of rapid seasoning

of Indian timbers are evolved, the only course open is to keep timber under proper conditions, generally for 3 years before use or, in case of certain species, to girdle the standing trees one to three years before felling them.

To supply timber suitable for rifle stocks both the Kashmir State and the Forest Department in Hazara Division in N. W. F. Province have recently erected plant for steam-seasoning the wood as employed in Europe and America.

Antiseptic treatment of timber—Another and extremely important development which is yet awaited for the economic utilisation of Indian timbers is their antiseptic treatment so that they may be immune to insect attacks and decay. For its full development the establishment of the manufacture of coal tar creosote is required locally.

The Pine Resin Industry—The resin exuded by the Low-level Himalayan pine is distilled into rosin and turpentine. The industry is confined to the United Provinces and the Punjab. It has great future before it. Something has been already said in the last chapter about the importance and extent of this industry.

Paper pulp industry—Materials for manufacturing paper-pulp abound in forests. Indian paper industry already utilises grasses and bamboos, but these give roughly about 40 % of bleached cellulose. Therefore the material contains about 60 % waste on which railway freight has to be paid for nothing. It would reduce the cost of paper, if paper-pulp factories be established on the borders of forest areas. Organisers will have to look not merely to the collection of the raw material but also to the keeping up of a permanent and continual source of supply. In foreign countries wood is utilised for the manufacture of pulp, but wood takes longer time to grow than grasses and bamboos. Besides it has been found that the cost of working bamboos into pulp yields a product cheaper than the imported pulp or unbleached sabai grass pulp.

Match-splint industry—The great drawback in the development of the industry of matches in India is to deliver suitable timber at the factory site within the working figure of cost. Railway freights which prevent this desideratum must be revised so as not to hit the local trade. Further, in order to cheapen cost, splint factories ought to be established in the vicinity of the spruce and silver fir forests in Northern India and prepared splints thence exported to central factories in the plains.

Lac Industry—Dealt with in the following chapter.

Collection of tan and other stuffs—This has been now more economically organised.

State Forests—Area of State Forests is over 246,000 square miles or roughly one-fifth of the whole of India and Burma. Of this over 100,000 square miles are Reserved Forests, over 9,000 square miles Protected Forests and over 137,000 square miles Unclassed Forests of which by far the greater portion occurs in Burma.

Chapter 7.—Lac Industry.

Production of lac—Lac is the resinous excretion of certain scale insects. Its commercial production is restricted to India, Siam and Indo-China. The last two supply about 2 to 2½ % of the total production which is well over 725,000 cwts. Even of the 2 or 2½ % production of the other two countries a considerable quantity comes into India *via* the Straits Settlement for manufacture into shellac. From this it is apparent how considerable a monopoly is held by our country.

The lac insect occurs on a large number of different trees. The nature of the host is a most important factor in the production of good lac. The best is grown on the *kusumb*, but the *ber*, *palas*, *pipal* and *babul* are all suitable for propagating the insect. In C. P., *kusumb* and *palas*

trees largely produce lac, in Sind the *babul*. The Sind *babul* lac has not thrived when transferred to *babul* trees in Bihar. It shows that various grades of lac are not solely due to the tree on which the insect feeds, but more to the fact that they are produced by different species. This aspect of the problem has not yet been thoroughly investigated.

There are 4 *crops* in the year of which the first is the largest :—

- | | |
|-------------|------------|
| 1. Bysakhi. | 3. Kushmi. |
| 2. Jethwa. | 4. Katki. |

The estimate of the yield of these crops is 925,000 mds. of sticklac. Add to this 90,000 maunds imported from Burma, Assam, Siam and Indo-China. Total 1,015,000 mds., or about 745,000 cwts. It gives from 40 to 60 % shellac. In all production of shellac is 475,000 mds. or about 348,000 cwts. The amount of shellac available for export is about 350,000 cwts.

Production is capable of being indefinitely increased. Practically it is limited only by the amount of labour available. In the past, the difficulty and expense of obtaining a healthy brood-lac was a serious obstacle, but it is going to be overcome by the establishment of nurseries of brood-lac. At present leases are given for the collection of lac and it is usual with the lessee to strip the forest of lac when his lease is going to expire, leaving practically nothing to propagate the insect afresh. This difficulty can be solved by excluding a certain percentage of brood-lac from the concession.

It has been customary for centuries for the Indian lac collector to take his crop while the incrustation is soft and wet and before the larvæ escape. This green lac is demanded by the shellac manufacturer because of the low melting point of the resin contained in lac, but in this way the lac-brood is destroyed. It leads to shortage of supply occasionally and subjects the lac-trade to the element of gambling. The custom of taking the greater bulk of the

lac before it is mature should be discontinued like that of early marriage which in most cases means consummation before parties are mature. In the case of lac, the only thing required is to leave the incrustation on the trees or to move the twigs to other trees so as to allow the swarming larvæ to escape. It will not only yield a full crop of resin, but will leave the brood to produce fresh resin and eliminate the gambling element from the lac-trade, make it steady and its price cheap.

Lac Substitute—Many exhaustive researches have been conducted with a view to producing a substitute for lac, but with no success. It does not appear probable that any artificial substitute will ever displace lac in the arts and manufacture of the world, so long as pure lac is offered at low and steady prices. It is therefore worth while to maintain the monopoly, India possesses, of a raw product essential in the art and manufacture of Europe and America.

Area of Occurrence—There are 4 main lac-producing areas in India :—

1. Central India area, including Nagpur and adjacent districts of Orissa and Bengal and the north-eastern forests of the Hyderabad state.
2. Sind.
3. Central Assam.
4. Upper Burma and the Shan states.

There are other areas as well, *e. g.*, in the Punjab, but the most important is the first from which manufacturers draw the bulk of their supplies.

Shellac—The raw sticklac is manufactured into shellac in a large number of small factories in the United Provinces, Bengal and Bihar, the most important localities being Mirzapur, Balrampur, Imamganj, Pakur and Jhalda. In addition to these there are 2 concerns in Bengal where machine-made shellac is manufactured by patent processes.

Commercial forms—The principal commercial forms of lac are :—

1. Sticklac—the crude material.
2. Seedlac or grain lac—the sticklac crushed, washed and dried in the process of manufacture into shellac.
3. Shellac—various grades of the manufactured article in flakes.
4. Button lac or tongue lac—the same as shellac but melted into button or tongue shape.
5. Garnet lac—dark red lac melted into thin slab form but not reduced to flakes. It is usually made to contain 10 % rosin, but can be made pure. Lower qualities of this and of button lac can also be made by an admixture of lac refuse.
6. Kiri—the residue left in the bag after the melting process, which contains a percentage of lac, sometimes as much as 50 % or even more.

It is generally admitted that machine-made lac cannot successfully compete, at any rate in certain grades, with the handmade article, the only complaint with which is that it is adulterated.

Uses—The uses of lac are many and various and have increased surprisingly during the last few years. Lac has become a military necessity, as it is used in the manufacture of military requisites. The following are its chief uses :—

1. Manufacture of gramophone records, sealing wax, buttons, lithographic inks, corundum and emery wheels, imitation ivory, oilcloth, varnishes and polishes.
2. Stiffening for silk and straw hats.
3. Making electric insulators and explosives.

4. Making of bangles, bracelets and toys and innumerable articles of common domestic use in villages.
5. As a cement for the ornamentation of ivory and metal-ware.
6. For filling ornaments.
7. Fastening haft to swords.
8. Preparation of white lac, which is an additive compound of chlorine and lac and rapidly deteriorates with heat.

Lac is dissolved in alcohol for wood polishes, metal lacquers, the lining of shell etc. It is dissolved in borax for the stiffening of felt hats and similar uses. It is dissolved in soda ash and water for the preparation of white lac, which is soluble in alcohol and yields a pale transparent polish.

Exports—Owing to its use in military requisites, lac acquired great prominence during the war. Since January 1917, 80,000 cwts., has been shipped to the Ministry of Munitions in 28 months at the guaranteed price of Rs. 42 per maund of 82 2/15 lbs.

(Figurs in thousands.)

Year.	Shellac and button-lac.	Unmanufactured.	Total.
	Rs.	Rs.	Rs.
1913—14	182, 85,	13, 73,	196, 58,
1914—15	153, 62,	6, 96,	160, 58,
1915—16	160, 46,	11, 29,	171, 85,
1916—17	256, 99,	23, 33,	283, 32,
1917—18	363, 39,	14, 39,	377, 78.

Exports of lac-dye have for several years practically ceased. Since 1912 separate figures are not available. In 1868-69, Rs. 795,000's worth of lac-dye was exported, but in 1878-79 exports fell to Rs. 195,000 and in 1909-10 to Rs. 80 only.

Value of trade—The total value of the export made now amounts to over Rs. 3 $\frac{1}{4}$ crores. It is partly due to inflation of prices. 10 years ago the value of this trade was 2 $\frac{3}{4}$ crores. The average of 5 years given above comes to 238 lacs of rupees.

Trade Organisation—The actual collectors of sticklac sell it to the *bania* who supplies the small manufacturer and between the latter and the actual shippers brokers again intervene. The whole trade is financed by the system of advances, even the small manufacturer frequently receiving advances from Calcutta brokers. The system is said to provide a good division of labour and risks.

Lac products—It was originally almost wholly for the production of the dye that lac was collected. Lac consists of 3 main constituents:—

1. Lac resin—the outermost portion of the incrustation.
2. Lac wax—immediately surrounding the body of the lac insect.
3. Lac-dye—mainly present in the body of the insect itself.

By the indigenous methods of production lac is produced containing undefined percentages of wax and added rosin. The wax is not separately recovered at all and the dye, if it is recovered, contains wax, impure rosin, organic matter derived from insect bodies and ordinary dirt.

Lac dye, is one of the fastest and brightest reds. It is said to be used for artistic rugs and *saris* in certain parts of India in preference to the synthetic article. It is certainly regrettable that practically all the lac-dye produced is at present thrown away. *Dye-liquor* has a manurial value,

if run straight to the field, on account of rich supply of nitrogen contained in it; but dry-cakes have far less value for this purpose owing to the absence of a sufficient quantity of phosphates.

From the crude *cake-dye* it is possible to obtain by simple methods—

1. A second grade lac-varnish.
2. A lac wax, similar to bee's wax in property and value.
3. Preparation of lac-dye of approximately constant composition. This dye is suitable for dyeing silk and wool and by suitable mordants can be made to give a pleasing pink shade to cotton. If supplied in a reasonably pure state, it should find considerable application.

The crude *cake-dye* is at present practically a waste-product. Its scientific treatment which will yield the three valuable products mentioned above, is therefore likely to be an immediately profitable undertaking.

Special products of lac are needed for special purposes, e. g.,—

1. The hatting trade requires a lac containing a certain percentage of resin and wax in order to obtain the necessary pliability.
2. Gramophone record requires a different quality.
3. For lacquering metals and polishing wood, pure lac-varnish containing no added rosin is best adapted.
4. For sealing wax, toys, various forms of art work special material is required.
5. For varnish freedom from colour is, in many cases, essential. The only practicable method,

apart from bleaching, so far used for removing colour is that actually employed by the indigenous worker, *viz.*, melting with sulphide of arsenic.

6. For purposes, except the production of pale varnishes, the colour of lac is of no moment. What is important is the percentage of resin and wax which should be definite and constant for any given purpose.

Therefore, *the line of development in the lac industry* lies in the direction of standardisation. This will need larger capital than is required for dealing with crude lac. Its financial success depends, to a great extent, on the stabilising of shellac prices which are at present liable to great variation. The cause of this is to be found partly in the present conditions under which lac is produced and partly in speculative holding of stock. If the first cause could be eliminated by more scientific methods of cultivation, there would be less inducement for the second to operate, and India, with the raw material in the country and with cheap alcohol in unlimited amount could, by intelligent cooperation with consumers, hold practically a monopoly of an increasingly valuable staple product.

Chapter 8.—Tanning and Leather Industry.

Effect of War.—The war has brought about important changes in the Indian Tanning Industry and in the export trade in hides and skins. Before the war Germany and America were the chief purchasers of Indian raw hides and skins. Since the war they are Italy, U. S. A., and England. Indian tanning industry has greatly developed and exports of raw hides have consequently been greatly reduced. The following figures of exports of raw and tanned hides and skins will make the position clear.

I. Exports of Hides from India.

Year.	RAW HIDES.			TANNED HIDES.		
	Quantity Cwt.	Value Rs.	Average price per cwt.	Quantity Cwt.	Value Rs.	Average price per cwt.
	(thousands)	(lacs.)	Rs.	(thousands)	(lacs.)	Rs.
Pre-war 1913	11,32	8,00	70.6	1,94.7	1,75	29.8
1914	8,97	7,17	79.9	1,87.7	1,98	105.4
War: 1914-15	7,14	5,25	73.5	2,17	2,41	111.0
1915-16	8,82	6,78	76.9	2,72	3,06	112.5
1916-17	8,94	7,49	81.6	3,22.3	4,47	138.6
1917-18	4,18	3,08	73.8	3,61.6	4,48	134.6

On March 31, 1918, Government Stock in Madras awaiting shipment was over a crore of rupees.

The quantity of raw hides exported was only slightly more than the quantity of tanned Lides shipped from India.

The average price of tanned hides was over 50 per cent more than the average price of raw hides.

II. Exports of Skins from India.

Year.	RAW SKINS.			TANNED SKINS.		
	Quantity Cwt.	Value Rs.	Average price per cwt.	Quantity Cwts.	Value Rs.	Average price per cwt.
	(thou- sands.)	(lacs.)	Rs.	(thou- sands.)	(lacs.)	Rs.
Pre-war, 1913	5,04	2,46	67			
1914	4,43	2,89	65			
War: 1914-15	4,08	2,54	62	1,17.4	2,33	198
1915-16	4,33	2,99	69	1,27.8	2,55	200
1916-17	5,67	6,90	122	1,26.9	4,85	297
1917-18	4,29	4,75	111	73.3	1,47	397

The tanning of sheep and goat skins is also a large industry in the same area where hides are tanned. In 1916-17 price of tanned skins in U. K., U. S. A., and Japan rose to a phenomenal level. The supply of tanned hides was therefore endangered, because there was competition for tanning bark. So that after 15th May 1917, all exports of tanned skins from India were prohibited. Permission was afterwards given and in 1917-18 only 37, 318 cwts. of tanned skins were exported. Their value was Rs. 147 lacs. Tanners of skins were turned to tanning hides.

East India Kips—Rough-tanned cow hides exported from Madras and Bombay have been known for a long time by the name of *East India Kips*. The war has demonstrated their value as upper leather for army boots. At least 3/5 of the upper leather used in the United Kingdom, in the manufacture of boots for the British and Allied Armies, has been supplied from East India Kips. In 1917, 80 million feet was required, while before the war average annual yield was 27 million feet. This means that in 1917, 3 times more Indian cattle were butchered for the supply of hides to make army boots than the annual pre-war average.

Action taken by Government—To improve the tanning and leather industry the Government took the following measures:—

1. Increased production of tanned Kips, suitable for army work.
2. Prevention of adulteration and improper weighing of hides.
3. Reduction of the loss of valuable leather caused by faulty flaying and branding of cattle.
4. Increase and systematisation of the cultivation of *tarwad*, the great tanning bark.
5. Experiments carried on to find suitable substitutes or a combination of tanstuffs giving the same result as *tarwad* bark.

6. Securing the services of an expert from England to assist in the work of development.

Research Work—Extensive researches have been made at the Government Research Factory at Maihar in Central India into finding suitable tanstuffs giving as good result as the tarwad bark whose great advantages in tanning are :—

1. It is very easy to use and quick in its action.
2. It adds weight and plumpness to the hides.
3. It produces a leather which is capable, after further treatment by the currier, of being turned to a variety of uses.

These qualities have not been found possessed by any other tanning material. But experiments have given promising results. The following combination has given satisfaction at the Government Tannery, Allahabad:—

Aoula twig bark	... 50 %.
Karunda sumac	... 30 %.
Dhawa sumac	... 20 %.

This combination offers to tanneries in Northern India a cheap means of producing excellent crust leather.

Some success has further been gained in producing a variety of mixtures of Northern and Central India tanstuffs which hold out prospects of a great extension of tanning in Northern and Central India.

The Research Factory has devoted much attention to the problem of profitable treatment in India of the low-grade, badly-cured "dead" hides which were, prior to the War, exported in large quantities to Germany, Austria and Italy, where in spite of the wretched raw material, good leathers were produced. The full results of these efforts cannot, however, be expected for many years to come.

In Europe, *liquor-tanning* finds the greatest favour. Efforts have been made in India to prepare from natural tanstuffs *Tannin Extract*, but it has been found that in spite of its greater bulk, raw material pays better and costs less. In India raw materials of almost every type are found in abundance, capable of yielding good results. Extracts are costly to manufacture and do not give as good a colour as raw tanstuffs.

Indian tanneries.—Indian tanneries have produced during the War greatly increased quantities of leather accoutrements of all sorts and boots for the army in India and the Expeditionary Forces.

The stimulus given to the tanning industry may be measured by the fact that 2 million pairs of boots are now being manufactured in a year or more than 20 times the pre-war figure.

The monthly output of the Government Harness Factory at Cawnpore has increased from £ 33,000 of leather in 1913-14 to about £ 2,00,000 during the first three months of 1918-19. During 1916-17, the total value of the outturn was Rs. 52½ lacs. First class leather is being turned out by this and other factories.

The war has, however, not provided any opportunity for developing *chrome-tanning*. It is probable that after the war there will be greatly increased opportunities for this class of tanning, especially in the production of glaze kid from Indian goat skins. A company has recently been floated in Calcutta for this purpose.

The Munitions Board has endeavoured further to stimulate the manufacture in India of certain classes of *leather goods*, previously imported from abroad. Encouraging results have already been obtained in the case of roller skins and picker bands, in the manufacture of which at least 8 firms in India are now engaged. Supply is greater than demand. Some export of roller skins has therefore been made to foreign countries, especially Japan.

Chief advances have been made in:—

- (a) the production of chrome leather belting,
- (b) the making of jute-pickers, and
- (c) the supply of sheep-skins for polishing rise in Burma

Chapter 9.—The Paper Industry.

Handmade paper.—The Chinese are credited with making the earliest known paper. The Mohomedans of Central Asia borrowed the art from them and with Mohomedan invaders it came into India. The earliest paper manuscript found in India dates from the first quarter of the 13th Century.

For many centuries, paper making by hand was a flourishing industry in many parts of India, especially the Punjab. The number of men employed in the industry must have been considerable, since in all the principal centres of manufacture arose separate villages or Mohallas called after the material.

The hand-industry survives to the present day and the methods employed are practically unchanged. The *bania's bahi-khata* is usually made of this paper which is prepared mainly from old rags, hemp and jute waste, waste paper repulped and strengthened by an admixture of fresh fibre. It was at one time, a jail industry and has again been re-introduced in some central jails.

In Europe the hand-industry remains of some importance and continues to produce the highest grade paper for account books and drawing purposes, but there seems to be probably little or no commercial future before its Indian sister.

Machine-made paper.—The commercial future of Indian paper lies with the machine. In India the first paper mill on European lines was opened in 1716, in the Tanjore district, at the Danish Settlement.

In 1811 another mill was established at Serampore. Its product was obviously of a distinct sort, since to this day the Calcutta Stationery Office receives occasional demands for "Serampuri paper," but most probably the paper was hand-made.

It is not until 1870 that we have record of a mill for the production of machine-made paper. In that year the Bally Paper Mills was started. The maximum output, at its prime, was 5,400 tons per annum. In 1905 these mills closed down and 2 of the machines out of 4 were taken over by the Titaghar Mills.

In 1879, the Upper India Couper Paper Mills was established at Lucknow.* The maximum output is 3, 300 tons a year.

In 1881, the Maharajah Scindhia established a Mill at Gwalior. This enterprise has a very chequered history. It produces 1200, tons a year. It has now been taken over by Messrs. Balmer Lawrie and Co., the Managing Agents of the Bengal Paper Mills.

In 1882, the Titaghar Paper Mills was floated as an Indian Company. 8 Machines are working and the output is 18,000 tons a year.

In 1890, the Bengal Paper Mills was started. It has 3 Machines working. The output is 7,000 tons a year.

In 1892, the Imperial Paper Mills were started, but in 1902 they were taken over by the Titaghar Mills.

In Bombay there are 2 Paper mills, one at Grigoan, making heavy brown Paper, utilised for the manufacture of rollers for ginning cotton, the other making wrapping paper. It has also undertaken to make 350 tons of paper of various sorts for the Bombay Government.

At Surat there is a small mill, but its output is negligible.

Lastly there is a mill at Travancore, producing brown wrapping paper.

Output—The total output of all the mills is roughly 30,000 tons a year. The total demand for paper in the country is put at about 75, 000 tons a year.

Raw materials—Notwithstanding that India produces an enormous variety of suitable paper-making materials, Indian Mills imported wood-pulp to the extent of about 13,000 tons in 1913. Indian forests abound in paper-making materials such as grasses, bamboos and wood, which are capable of producing better and cheaper pulp. The only thing required is to establish pulp-factories at the sources of supply. If this could be organised, India might become the exporter of an excellent variety of pulp.

Research—For a number of years past Government had been conducting investigations as to the utilisation of new fibres, speceially bamboo and wood pulp, but no really practical advance in the commercial exploitation of India's great natural resources has yet been made.

Effect of war—Before the war Indian mills were undersold, so that the industry was in a very shaky condition. Capital was shy. The war has enabled Indian paper mills to strengthen their position. The profits which they have made have enabled them to make ample provision for extensive refitting of their mills.

War has directed attention to the use of such grasses, as *sabai*, *baib* and *bhabar* on an extended scale and to other available raw materials.

The war stimulated the manufacture of certain descriptions of paper formerly imported, e. g., —

1. The thin bank paper used for type-writing.
2. Soft-sized impression paper for use with duplicating machines.
3. Substitute for latrine paper— a thin brown paper.

4. Wax-paper — a special line outside the activities of ordinary paper mills, produced by an Indian firm of Calcutta.

5. Carbon paper—not yet satisfactory. A European firm in Calcutta has now plans on foot for producing it.

6. Post-cards— no less than 63 millions have been provided by Indian mills.

7. Pasteboard and straw board—used for bookbinding, not yet thoroughly successful.

8. Paste for pulp board for the manufacture of railway-tickets—not yet satisfactory.

The last two are fertile fields now lying fallow. There are *goods prospects* of the production of strawboards and machine-made pasteboards of European quality at a comparatively early date.

The paper mills in India have supplied paper to the armies in India, Mesopotamia and to some extent in Egypt. Further the wants of civil administration in India and in some of the further East Colonies have been so met that all essential publications have been maintained without break.

Future prospects—The future development in the paper industry depends on the development of associated industries such as the manufacture of bleaching powder, caustic soda, rosin and china clay.

With the wealth of the fibres to draw upon and with an adequate supply of chemicals at a reasonable price, India ought to be in a position not only to produce internal requirements of ordinary paper, but also to become one of the great pulp-exporters. Some measure of protection would probably be necessary to these nascent industrial developments to attain the required strength.

Chapter 10.—Glass Industry.

History—Although Pliny mentions 'Indian glass' as being of superior quality owing to its being manufactured from crystals, no traces survive of an ancient Indian glass industry. All that is certain is that in the 16th century it existed as an established industry, manufacturing bangles, phials and flasks.

The manufacture of glass and glass articles in factories is only a quarter of a century old. Between 1892 and 1900, 5 glass factories were established. Two of these were Indian. They did not survive long. Three were under European management. Though amply supplied with capital and equipped with large modern smelting furnaces, they all failed by 1908. Another European venture was made in Madras in 1909, with no better results. The company went into voluntary liquidation after 3 years.

The Indians, undeterred by failures, started 16 glass factories between 1906 and 1913, on a small scale. Of these only 3 were in operation at the outbreak of War, but none proved a success in the commercial sense of the term. The Talegoan factory is said to pay its way under the aid of the Paisa Fund. It is run on somewhat peculiar and non-commercial lines. It has kept up a constant supply of fairly well trained glass-blowers.

Present Position—There are at present 20 glass factories at work in India. Of these 7 are situated at Ferozabad and entirely engaged in the manufacture of *churi* glass which is purchased and re-melted by bangle-makers both in the United Provinces and the Punjab,

Glass is made from imported soda with lime from Katni and sand from the south of Allahabad. The coal comes from Bengal. Ferozabad thus possesses no advantages, natural or otherwise, for the manufacture of glass except that of labour. 4 lacs of *capital* is estimated to have been invested by Hindu capitalists. The *output* of glass is between 20 and 30 tons a day. The glass is soft.

It is obtained by the use of a considerable proportion of alkali. It is prepared in a great variety of colours. There are at Ferozabad between 50 and 60 factories making bangles. No improvements have yet been made in the methods of working. A Parsee firm established there, since the out-break of war, has made considerable strides in the manufacture of bangles in imitation of those formerly imported from Austria. *Bangle-industry* is at present very flourishing. It represents a turn-over of at least 20 lacs of rupees per year and probably supplies 1/3 of the Indian demand for bangles. The Ferozabad industry is undoubtedly *the best established branch of the Indian glass trade*. Improvement of methods and education of bangle-makers will ensure its future.

Progress since the war—It is evident that substantial progress has been made during the last 10 years, much more so during the war. Lampware, bottles and carboys are now being manufactured by 12 glass works. Stimulated by the war demand several factories have turned out glass tubing, flasks, beakers, dishes and test tubes. One or two small concerns have been started to work up glass produced elsewhere to meet the demands of the scientific laboratories controlled by the Indian Medical Service. Apart from the bangle trade, the *capital invested in glass works* is not less than 15 lacs of rupees.

Glassware for laboratories of reasonably good quality are now being turned out by —

1. The Upper India Glass works, Ambala.
2. Bijohi Glass works, Moradabad.
3. Allahabad Glass works, Naini.
4. The Scientific Instrument Company, Allahabad.

It is hoped that eventually most of India's requirements in this direction will be manufactured in India.

Imports—Imports of glass into India are given in the following table:—

(In lacs of rupees.)

Articles	1913-14	1916-17	1917-18
	Rs.	Rs.	Rs.
1. Bangles	80	43	35
2. Beads and false pearls	24	21	24
3. Sheet and plate glass	22	28	23
4. Lampware	17	11	18
5. Bottles and phials	14	16	} 37
6. Sodawater bottles	6	9	
7. Table ware	8	7	10
8. Miscellaneous	19	15	15
Total	190	150	162

These figures should be interpreted with caution. Values have enormously increased. Current prices are double of what they used to be. *Nearly 1/2 the requirements of the consumers have been met by the Indian glass works. The value of the outturn of organised glass factories may be put at 20 lacs of rupees a year and if we add to this the value of bangle-glass trade, the total must come up to 40 lacs of rupees a year.*

Prospects—The Industry has reached considerable dimensions under the stress of War conditions, but in order to develop it further it is necessary to put it on scientific lines. The industry, even in its simplest form, is a highly technical one and requires scientifically trained experts. Its secrets in other countries are carefully guarded. How to set about the task requires careful consideration.

It is difficult to assign adequate reasons for the location of existing factories. Personal element seems to have been the determining factor. Existing factories are situated at a distance from the sources of the materials needed and will therefore be greatly handicapped in competition, in normal times. It is feared that even protection will not help the existing factories, for if the industry is to be developed on sound lines, new factories will be their most formidable competitors. These new factories must be

located with due regard to the advantages, secured by being near the sources of materials required in the manufacture. It, therefore, seems likely that old factories will succumb to either external or internal competition, if Railways do not grant them special concessions for the transport of raw materials and manufactured wares.

Problems requiring investigation — The most urgent problems requiring investigation in the immediate future are: —

1. Design and construction of furnaces to save waste in fuel.
2. Manufacture of crucibles and pots.
3. Provision of suitable fire-resisting materials.

Furnace-defects are responsible for the difference between the value of the outturn of a good working day and the average as struck from the year's outturn.

Before the war Japanese crucibles cost Rs. 20 each. Now they cost Rs. 80 each. No one in India has yet succeeded in making crucibles, though experiments are in progress.

The most successful glass works are situated at Naini, near Allahabad. Difference as to the advantages of location can be realised by comparing the following figures of the prices paid for raw materials at Naini with those at a recently established concern in Bombay:—

	Naini.	Bombay.
Sand	... 4 as. per maund	... 15 as.
Limes	... 16 as. per maund	... 32 as.
Soda ash	... Rs. 9-6 per cwt.	... Rs. 9.
Coal	... Rs. 13 per ton.	... Rs. 24.

Fuel is an important item of the cost. Then Bombay is fully exposed to foreign competition, while Naini is

comparatively protected by a railway lead of several hundred miles.

A glass factory stands a better chance of surviving, when it is situated near a coal field. With gas-fed furnaces, coal will not be of so much importance.

Usar lands contain carbonate as well as sulphate of soda. In the past they were the basis of an indigenous glass industry. It is possible that investigations may bring to light deposits sufficiently rich to make it worth while extracting the salt and refining it.

At present the glass manufactured is soft soda glass, suitable for a limited range of wares. *If the industry is to expand, production of better qualities of glass suitable for a wider range of articles must be undertaken. For this we shall require trained glass technologists. Useful work has been done by the Paisa Fund Factory at Talegoan in training glass-blowers and the expansion that the industry has made under war conditions, has been chiefly due to the supply of men from this place, but the men require further training in order to produce glass-ware of superior quality.*

Labour difficulty is the chief one. Fresh hands cannot be sufficiently well trained in sufficient numbers. To remedy this drawback a Government Glass Factory, equipped with an efficient technological laboratory seems to be essential.

For packing glass-ware crates made of reeds growing in the Ganges have proved very satisfactory.

In the glass industry, there is little waste of the raw materials in the process of manufacture. Fuel only is an important factor. Unless cheap electrical energy is available, the ideal conditions for the manufacture of glass would, be realised, if suitable sand could be found in proximity to coalfields.

Attempts to utilise electric furnaces for glass melting have met with some degree of success.

Chapter 11.—Soap Industry.

Imports—Imports of soap into India had been steadily growing for some years before the war. The average of imports of soap in the six years including the war period was 18,536 tons or 997 tons in excess of 1912-13 and 393 tons in excess of 1913-14. The aggregate military demand was 300 tons per annum. The present normal supply may be taken as 18,500 tons.

Toilet soaps were valued very highly, *viz.*, Rs. 57 per cwt., in 1912-15 in comparison to other soaps valued at about Rs. 16 to 20 per cwt. Figures for imports are the following:—

(*Figures in thousands.*)

Year.	Quantity	Value.	Rate per cwt.		
	cwt.	£	£.	s.	d.
1912—13	3,51	4,76	1	7	2
1913—14	3,63	5,00	1	7	6
1914—15	4,04	5,55	1	7	5
1915—16	3,74	5,64	1	10	1
1916—17	3,80	6,73	1	15	5
1917—18	3,25	7,56	2	2	11
Average 1912—15 (3 yrs.)	3,73	5,10	1	7	4

Before the war little over 3 per cent of the imported soap came from foreign countries. Now Japan and the United States are coming to the front as suppliers of soap to India. Of soaps from foreign countries the bulk (76 %) in 1913-14 was toilet soap of which in that year Austria sent 43 %. Now Japan takes the lead in that line.

Production in India—There are, large and small, altogether 56 factories in India. Their possible output is at present 22,000 tons. This can be increased to 35,000 tons.

Prices at which soaps were offered to the Munitions Board varied from Rs. 35 to Rs. 8 per cwt., the former for first class soaps equal to high class English bar soap, the latter being for the lowest grades, which are actually soap more by name than quality. In India high class soaps form only 1/16 of the output. 77% of the total Indian output are soaps priced at between Rs. 10 and 20 per cwt.

Extent of Competition—The average price of imported soaps till recently was Rs. 17 or 18 per cwt., wholesale. Since imports also include high grade soap priced between Rs. 20 and 30, much of the soap may be put at Rs. 14 per cwt. of 108 lbs. Toilet soaps average at as. 8 per lb. Here we have a measure of the competition to be met.

Considering the prices of raw materials which are fairly even throughout the country, it seems impossible that genuine soaps can be sold at many of the low rates at which they are offered. In India soaps are offered at Rs. 8 to Rs. 35 per cwt. Now fats and oils alone cost on the average Rs. 16 per cwt., which price is much below present rates. Then caustic, fuel, labour, supervision, depreciation, interest, packing and office charges, profit, etc., have to be taken into account.

Soaps are diverse in composition. Imported soaps are too skillfully made to readily betray their low quality, being largely able to retain form, colour, and general appearance. Some imported soaps made "specially for export" in exporting countries have been found to contain only 11% fatty acids and above 80% water. Further they contain mineral fillings to increase the weight. Under these conditions of the soap trade, to meet foreign competition appears to be a hard problem.

The problem of the Soap Industry—If the quality of the Indian soap can be improved without raising its cost, India should more than hold its own. It is possible so to develop the soap industry as to supply not only a growing demand within the country, but also to permit of exports.

The problem depends for its solution on the solution of major problems presented by the several oils and fats industries, viz., oil-pressing; edible oil and fats industry; manufacture of glycerine, whether as a by-product in soap-making or as a direct product in fat-splitting; the manufacture of candles; paints and varnishes; the hardening of fats as edible or technical material. The assistance of agriculture is also an essential factor both in providing a constant supply of cheap vegetable oils and in absorbing the oil-cake.

The Indian Industry has the following points in its favour:—

1. Abundant and increasing supply of all oils and fats, suitable for hard or soft soaps, in the freshest condition, near the factories.
2. Certain of these oils, notably coconut, lend themselves to simple and rapid methods of manufacture of cheaper grades of soap which will always be in demand.
3. Labour, land and buildings are all cheap compared to other countries.
4. Taxation compared to other countries is small specially for small factories outside municipal areas.
5. A duty of $7\frac{1}{2}\%$ on imports.
6. Small factories can be established controlling purely local markets.
7. Markets are at the very door of factories so that freight, packing and other charges must be nominal.
8. Factories can suit their product to local prejudices or conditions in their composition of soaps, their solubility in hard and brackish waters, appearance, perfumes, etc.

9. Beef and mutton tallows and pig fat so largely used in the manufacture of imported soaps can be altogether avoided and soaps produced without animal fats.
10. Fish oils, available either crude or hardened for certain uses, are cheap.

The following are the drawbacks of the Indian soap-maker: —

1. The masses of cheap materials, used by the Western Soap-maker as substitute for tallow, i e., kitchen stuff, melted fats, bone fat or bone grease, waste greases from ships, factories, railways etc., are not available to the Indian soapmaker.
2. Caustic alkalies are not made in India and must be imported.
3. Western Soap Factories, some of them, have immense capital and own plantations and lines of steamers to cheapen their raw material as well as the finished product. The Indian soapmaker is devoid of the advantages assured by a large command of capital.
4. Want of knowledge—comparative absence of well trained and instructed soapmakers.
5. Want of capital results in putting goods on the market, poor in composition as well as in appearance and in making makers unable to survive determined competition and the dumping of goods at low or cost price.
6. Insufficient initiative and push due to—
 - a. Want of knowledge,
 - b. Want of capital, and
 - c. Tropical conditions of life.

7. Connected industries, not merely those of the oils and fats group but of necessary side lines, such as box making, lithographic and colour designing and printing, are either wanting or weak.
8. Difficulty of the recovery of glycerine owing to the smallness of the individual output, the expense of the plant and the expense of lead for parcels of crude glycerine, if sent to central distilleries.

Discussion of drawbacks—(1) Waste greases in the West are cheap compared with good tallow. Many oils in India are not dear compared with the price of waste and bone greases. *The advantage with oils* is that they require no refinement or manipulation. In India there are sources of waste fats in large cities and seaports, but these require organisation. An enquiry, is being made at Calicut, where there are bone factories for recovering greases. Cotton seed soap-stock is another very important cheap material. It is available in small quantities in Bombay and as oil pressing industry develops, will be available in increasing quantities.

(2) Absence of caustic alkalies is not very material, since it forms only 10 per cent of the weight of finished soap. *Caustic soda* is already made in India and there are going to be further developments in its manufacture. *Caustic potash* for local needs may be obtained, at factory centres, where wood-fuel is burnt, by bleaching wood ashes from the furnaces.

(3) Small capital is not a very bad disadvantage. Small factories supplying local needs are very numerous in Europe. Small manufacturers are their own experts; their expenses on office, advertisement, commission etc., are small and nil. They can entirely cut-distance competition, specially in toilet soaps. Only they must be thoroughly instructed.

(4)—(7) These disadvantages are remediable by time, experience and the development of oils and fats industries.

(8) As regards glycerine, most of the small factories will probably work on those processes in which glycerine is not separated but remains in the soap. This is a distinct loss, since crude glycerine is twice as valuable as soap; but the loss is largely compensated by the ease, rapidity and cheapness of manufacture, by the improvement in soap and by the weight of glycerine added to the soap. Large factories can have their own recovery plant and experiments tend to show that crude glycerine may be cheaply recovered in this climate, without the usual vacuum plant.

Prospects—*Tallow* is a most important ingredient in hard soaps in the West, but in India this is not very important since Indians demand soaps without any animal fat. Then oils, vegetable fats or semi-vegetable fats are abundant and cheap. England gets tallow from Anstralia and the Argentine. Australia being much closer to India, it should be easy to divert part of the Australian tallow to India at favourable prices.

It is in the hardening of oils by hydrogenation that a *remedy* exists for the *paucity* of tallow. The cost of hardened fish oil on the Madras coast would be about $\frac{1}{2}$ the price of tallow. Vegetable oils can similarly be hardened and used for making hard soaps. It appears, therefore, that the use of hydrogenation, especially when hydrogen will be obtained as a by-product in electrolytic industries under contemplation, will entirely compensate for the comparative paucity of tallow.

The abundance and suitability of high-class materials, the existence of perfumes suitable to Indian tastes, the nature of the industry that it can be conducted on a small scale and the duty which is considerable on soaps worth £ 3 to £ 4 per cwt, should give India a preponderance in high class soaps, both for local use and exports. Technical matters as to appearance both in size and shape, perfume,

colour, gloss, beauty of design and packing are being carefully considered and studied at the Madras Government Factory at Calicut.

Chapter 12—Cement Industry.

The Ferro-Concrete age—The steel age is giving place to the cement and steel age, the ferro-concrete age. The use of ferro concrete, comparatively new even in the Western world, is extending very rapidly. Bridges, heavy structural works of all kinds and even ships are being made of it. But in India comparatively little has been done in this direction. But this class of work is bound to have very great expansion in the near future. The opening up of Mesopotamia will afford a large sale for Indian cement.

A war Industry—At the outbreak of War there were no factories in India producing cement up to the requirement of the British standard specification, Portland cement. The works of the Katni Cement Company and those of the Indian Cement Company at Porbander were under construction, but did not start fully till 1915, while the Bundi Works were not in full swing till 1916. The output of these 3 works is now 15,00,000 cwts. per annum. The bulk of this was taken over by the Munitions Board, so little has, hitherto, been available for the private consumer. The output of these works being very much short of present demands even, it will obviously not suffice for future requirements and there is still room for additional works. The size of the country renders it imperative that the distance from the factory to the constructional site be not great, because a factory on the spot can supply much cheaper than either the imported article or that manufactured in another part of the country. It is to be hoped that the next few years will see each important part of the country supplied from a factory near at hand.

Location and manufacture—Location of sites of factories is not always easy, but necessary materials being available, it should not be impossible to find suitable situations.

Each ton of cement requires between 8 and 10 cwts. of coal for its manufacture. So the cost of fuel is an important matter.

Present position and prospects—The present position of the Portland Cement Industry is fairly satisfactory. Existing companies have proved that excellent cement can be made in India at a profit. Both internal and external conditions after the war are likely to be favourable to the industry. Owing to the heavy demand for British cement for reconstruction purposes in Europe, the amount available for export from England will be small and conditions in the United Kingdom and high freights are likely to keep the price of imported cement far above the pre-war level. To a lesser extent the cost of freight will keep up the price of Japanese and Hongkong cement also. These conditions are very favourable to manufacturers in India.

Chapter 13. Magnesite Industries.

The finest Magnesite in the world—Very extensive deposits of some of the finest magnesite in the world are found at Salem in the Madras Presidency, but these deposits are not yet worked to the extent compatible with their size. There is yet a small demand both in the country and outside for export purposes. The world's demand being large and the only other deposits comparable in quality to the Madras product being of Grecian, German and Austrian origin, it is possible that export trade may develop to a considerable extent.

A raw material for several industries—Magnesite may be used as basis for the following industries —

(1) *Manufacture of cement*—Magnesite cements are too hard and expensive for ordinary use, so that they will have to be mixed with some inert material, like sand, asbestos, sawdust or emery. Magnesite cements require magnesium chloride. It has been found that bitter water makes a very effective substitute for all except the highest grade

cements. An enormous quantity of this bittern water is thrown away at all common salt factories and can be had at a nominal price.

(2) *Manufacture of artificial stone*—5 parts of magnesia with 95 parts of sawdust will make medium quality artificial stone. If the proportion of magnesia is raised to 15 per cent, the stone produced is stronger than nearly all the natural stones, used for building purposes.

(3) *Manufacture of imitation marble.*

(4) *Manufacture of emery wheels*—Emery mixed with about 15 per cent of cement and the product moulded, emery wheels of fair quality can be obtained.

(5) *Manufacture of springy flooring*—Where sawdust is used as the filling material, the resulting product is springy and makes an admirable flooring which can be laid down without joint and fitted into any shape desired. It is usual to cover the springy layer with another one containing a mineral filling. This upper layer can be made of any colour and finally polished.

(6) *Manufacture of tiles.*

(7) *Manufacture of firebricks*—Magnesite is a very valuable material for making bricks for lining furnaces. All the magnesite bricks required by the Tata Iron and Steel Works are manufactured by the Kumardhubi Fireclay and Silica Works and are quite equal in quality to imported bricks.

(8) *Manufacture of Epsom salts*—Produced by treating Magnesite with sulphuric acid. Manufactured by several firms in India during the war. Future of this industry will depend upon 2 factors—(a) cheap sulphuric acid and

(b) competition with salts produced from bitterns.

Chapter 14.—Shipbuilding Industry.

Impetus given by the war—The requirements in the matter of water transport of the overseas forces in the East during the last 2 years of war and the need for sea-going tonnage have given great impetus to the shipbuilding industry in India and Burma.

The Indian Rivercraft Board—In 1916 the Government of India created a special agency to organise the work of construction. The main idea in the formation of this agency was to secure the full co-operation of the Engineering Trade. The Indian Rivercraft Board was constructed at Calcutta with sub-committees at Bombay, Karachi, Rangoon, Colombo and Singapore.

Arrangements were made for the construction of a large number of rivercraft of various kinds sent out from England in plates and angles. The main portion of this work was carried on at Karachi where a large shipyard was laid down with building accomodation for 20 rivercrafts.

In Calcutta, the work consisted principally of the construction of 125 ft. steel and composite barges, of 50 feet Steel barges and of pontoons for 2 large floating bridges. A large number of motor launches, anchor boats etc., was also supplied.

In Bombay, the same kind of work was carried out as in Calcutta. Besides re-erection of hospitalships was undertaken, these being large and very complicated vessels.

In Rangoon, a composite barge, a large number of wooden anchor-boats, cutters and dinghies were turned out. In Singapore and Colombo indents for plant of all kinds were met.

Shipbuilding branch of the Munitions Board—In December 1917, as a result of enquiries from the British Government as to the capabilities of India for the construction of ocean-going oil-driven ships, sea-going tugs and steam trawlers, a shipbuilding branch of the Indian Munitions Board was organised at Calcutta. The Indian River-

craft Board being now found un-necessary, was dissolved in June 1918.

Since the organisation of this Branch in December 1917, a considerable number of tugs, motor boats, lighters, mooring boats, anchor boats, canoes, dinghies, marine motors, buoys, and spare parts such as rudders, propellers, and shafting, have been supplied to overseas forces, while under its supervision the building of mine-sweepers for Indian coast defence was undertaken (6 at Calcutta and 3 at Bombay).

Investigation of shipbuilding Possibilities—Investigation of shipbuilding possibilities brought out the fact that wooden sailing ships could be built in India, while it was not found practicable to undertake the construction of steel and composite steamships owing to—

1. The necessity of importing the bulk of the steel materials, equipment etc., as well as the boilers and engines.

2. The limited and uneconomical size of steel steamships which would be constructed with existing facilities in India.

3. The present heavy demands on engineering establishments for munitions of war, which could not, without jeopardy, be met concurrently with shipbuilding.

4. The ability of shipyards at Home to use all available supplies of steel material with results more beneficial to the Empire than could be produced in India.

Under construction—At present there are under construction in India and Burma 44 sea-going wooden sailing ships, varying from 100 to 1,000 tons carrying capacity in the following places :—

Burma—Rangoon and Moulmein.

Madras—Calicut, Muslipatam, Cochin.

Bengal—Calcutta, Chittagong.

Bombay—Versova.

Ferro-Concrete Vessels—The possibility of constructing ferro-concrete vessels in India was not overlooked. Before embarking on the enterprise, the Government is advised to await the results at Home and abroad.

Canvas—Canvas of suitable quality for use in sails is not at present produced in India.

Chapter 15.— Jute Industry.

History—The modern Indian Jute Industry is essentially a development of the last 80 or 90 years, i. e., since the year 1828. Even before that year jute was grown over almost as wide a tract as it is to-day, but the average devoted to the crop was far less.

Before 1828, the whole of the jute fibre produced in India was manufactured locally by hand into numerous articles including clothing and export was confined to hand-made products, such as gunnies. In 1828, the first export of raw jute to Europe was made. It was during the Crimean and American Civil Wars, the first of which shut off Russian flax and hemp and the second American cotton, that jute began to be used on a really large scale. Increase in the production of jute is exhibited in the following figures:—

(Figures in lacs)

Year,	Area under jute Acres.	Produce Bales of 400 lbs.	Approximate Value.
1874	...	27,	Rs. 5,40,
1902	21,42,	66,	16,00,
1909	98,76,	90,	36,60,
1914	33,58.	105,	50,00,

Thus the yield of fibre has increased by 300 per cent. in 40 years.

In 1851, the value of the *exports* of raw and hand-manufactured jute was about 40 lacs of rupees and the *price* of fibre was from Re. 1 to Re. 3 per maund.

In 1914, the value of raw fibre produced was about 50 crores of rupees and the price of fibre was from Rs. 7 to Rs. 12 per maund.

Effect of war—At the out, break of War the export of raw fibre was cut off. Combined with this was a very large crop. The result was a heavy slump in the price. Area of jute fell by 30% in 1915-16. After that recovery was only partial. In 1918-19 the price of fibre was high, as the export of raw fibre was resumed.

It must be recognised that very heavy prices will encourage either the production of jute elsewhere or will lead to substitutes, artificial or otherwise. Either of these would mean the breaking up of the monopoly in the supply of jute which India has hitherto enjoyed.

Jute mill Industry—In 1808, the value of jute yarn was discovered and the Dundee Jute Industry was born.

In 1858, the first spinning machinery was brought out to Calcutta from Dundee. Production was 8 tons per day. Now it is 3,000 tons a day or more than 5 times as much as the consumption of Dundee. It amounts to nearly $\frac{2}{3}$ of the total production of jute. The following table shows the increase in the number of jute mills in Bengal :—

Year.	No. of Mills.	No of Looms.
1855	1	...
1870	5	1,250
1880	18	3,500
1891	24	8,814
1901	34	15,336
1910	45	32,944
1917	71	40,639

Prior to the war, the Calcutta Mills had practically confined themselves to the manufacture of gunnies and hessian cloth, but *with the advent of war* they were required to manufacture large numbers of sandbags for the trenches.

Development of jute manufactures—The over-running of Russia by Germany in 1915-16 cut off the supplies of flax to the Allies and then began to be felt shortage of this fibre for the manufacture of huge quantities of tent cloth, tarpaulins, waggon-covers, groundsheets, waterbuckets etc. Recourse was had to jute of which 5 million yards has been made and supplied for war purposes.

Jute Canvas is practically a war development—Although jute canvas is inferior to flax canvas in durability, when in contact with earth or exposed to continued damp, the fact remains that it met an emergent want and restored an intolerable position and has no doubt come to stay, for for certain purposes it will always have a ready market.

The control of jute—The control of jute effected a saving of not less than 2 crores of rupees in 1918 alone to the British and Indian Governments.

Chapter 16 —The Hardware Industry

Hardware—Hardware is known in the trade by the name of "shelf goods". Outside the trade the term "iron mongery" is in more general use. It includes.—

1. Electroplated ware and cutlery.
2. Agricultural Implements.
3. Domestic utensils.
4. Iron and galvanised Iron Buckets.
5. Lamps of all kinds.
6. Machine tools, *i. e.*, tools for use in metal cutting machinery.
7. Hand tools for all trades.
8. Small machinery worked by hand.
9. Brassware such as gas, water and electric fittings.

10. Fire hydrants, cocks and taps, safes and strong boxes, etc., etc.

Trade in Hardware—Before the war, the bulk of India's requirements was imported and in the years 1912-13 and 1913-14, the total value of all kinds of hardware imported averaged to nearly $2\frac{1}{2}$ millions sterling.

Effect of war—On the outbreak of war the British Government prohibited the export of hardware almost entirely, except under license, for such articles as were considered directly or indirectly necessary for the prosecution of the war. This state of affairs naturally stimulated the manufacture of certain articles in this country and also led to increased but inadequate imports from Japan and America. American goods were satisfactory but Japanese goods were of inferior quality.

Troops in the field require large quantities of hardware. Where imports were curtailed, the deficit was, to a certain extent, made up by factories in India. This was particularly so in buckets of galvanised and tinned iron as will be clear from the figures of imports—

Year.	Imports of Buckets of galvanised and tinned iron;
	£.
1913-14	67,065
1914-15	45,103
1915-16	9,789
1916-17	8,568
1917-18	6,298

These were imported almost entirely from the United Kingdom.

Imports of other hardware are shown in the following table:—

Imports of Hardware.

(Figures in thousands)

Articles.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.
	£	£	£	£	£
1. Builders' Hardware ...	164,	95,	115,	146,	122,
2. Domestic Hardware other than enamelled ware ...	124,	62,	51,	58,	44,
3. Enamelled Ironware ...	184,	66,	57,	131,	123,
4. Implements and tools, other than agricultural implements and machine tools ...	271,	225,	210,	210,	245,
5. Lamps, metal and glass ...	284,	129,	157,	209,	156,
6. Miscellaneous Articles ...	1,224,	933,	868,	1,151,	964,
Total ...	2,355,	1,512,	1,460,	1,908,	1,657,

(126)

Changes owing to war—(1) Before the war, builder's hardware such as locks, hinges, doorlocks etc., came in almost equal parts from Great Britain and Germany. Imports from England have dropped over 50 per cent. America and Japan have supplied increasing quantities. Local manufactures have also greatly developed, so that shortage in this has not been so marked as in most other classes.

(2) United Kingdom and Germany were the principal importers. Their trade has fallen precisely in the same way as in (1). Other countries have not stepped into the breach.

(3) Before the war, this trade was entirely in the hands of Germany and Austria. At present Japan is the largest importer. Two companies in Calcutta have already taken up the manufacture. With iron-sheets made in India these ventures appear to have good prospect, in future, before them.

(4) In this line, before the war, Japan was unimportant and negligible, but now it has taken up the share which used to be supplied by Belgium. The United States have trebled their imports. Local manufacture has been hampered by the shortage of tool steel which is not yet made in India.

(5) Before the war Germany and Japan were the largest suppliers of cheap metal lamps, while the U. S. A. of the better class. A good quality of cheap metal lamp is now being successfully made in India. Of the glass lamps, Japan had the bulk of the trade and the rest came from Germany. Even Japanese supplies have dwindled since the war. In India these are not yet made, as no moulded or pressed glass work is yet produced within the country. The number of metal lamps imported has fallen from $46\frac{1}{2}$ lacs in 1913-14 to about $11\frac{1}{2}$ lacs in 1917-18, while that of glass lamps from $7\frac{3}{4}$ lacs to 58,000.

Change of Direction in the Hardware Trade—Before the war Germany and Austria were extensive suppliers of Hardware to India. Now their place has been taken up or

rather more than taken up by Japan and the United States as the following figures will show :—

Shares of Principle Countries.

Countries.	1913-14.	1917-18.
	£	£
1. United Kingdom ...	1,300,000 or 54·77 %	652,000 or 39·34 %
2. Germany ...	461,000 or 19·57 %	
3. Austria ...	179,600 or 7·64 %	
4. Japan ...	30,000 or 1·27 %	421,000 or 25·4 %
5. United States.	244,000 or 10·36 %	477,000 or 28·78 %

The above figures make it clear that in 1913-14, 5 countries supplied to India over 93 per cent of hardware, while in 1917-18 the same percentage was supplied by 3 countries, England, Japan and America. England's share has decreased from 54·77 per cent to 39·34 per cent, while Japan's share has increased from 1·27 per cent to 25·4 per cent and that of America from 10·36 per cent to 28·78 per cent.

Prospects of manufacture in India—India has not been able to seize the opportunity, offered by the war, of securing a permanent hold on the hardware industry. The reason is that most of these articles are durable and machine manufactured; their value is often considerable in proportion to their bulk and they bear the cost of carriage over long distances. Therefore hand-made Indian articles stand no chance of competition until the use of machinery becomes far more common than it is at present. The drawbacks of the present will in time be surmounted. New ventures in this line are at present largely in European hands, but once local manufacture becomes established, there is reason to suppose that, with the supply of trained labour made available by the pioneer firms, other concerns will be started and by degrees a great proportion of India's requirements will be manufactured in the country.

Chapter 17.—Miscellaneous Industries.

Natural Dyes—Before the introduction of aniline dye, the natural dye industry was one of considerable importance. Its replacement by synthetic or coal tar dyes has been due to 2 causes:—

1. Low price of aniline dyes.
2. Much greater varieties in shades and tints which could be obtained by the use of aniline dyes.

India is extremely rich in natural dyes, but it is doubtful if, apart from indigo, catch, safflower, turmeric, annatto and red sanderswood, any one of them finds more than a local use. Very little has yet been done to develop indigenous dyes.

Indigo is outstanding in importance and the desirability of reviving once more the cultivation of this dye has been clearly recognised. The investigations of the Indigo Research Chemist have already met with considerable success and the dye has been put on the market in a form which enables it to compete more readily with the synthetic dye.

Catch finds considerable application as a dyestuff and is used largely for obtaining various shades of brown, olive, grey, drab and black. It can be used both for animal and vegetable fibres. It also gives an excellent result with silk. Its use on wool is restricted because it makes fibres harsh. As a cotton dye also, it can hardly compare for fastness with the aniline khaki dye.

Medical and Surgical Requirements—In order to relieve, as far as possible, the strain on the resources of the United Kingdom and to economise in freight, every effort was made to manufacture in India, articles formerly imported, e. g., surgical dressings as cotton wool, gauze, lint, etc. Private enterprise is largely responsible for the supply of medicated and compressed dressings completely sterilised. The success attained has effected a considerable saving to the Government, as the price in the English market had

vanced 400 % over pre-war rates. In the Medical Stores Depots at Madras, Bombay and Lahore, analytical chemists are now manufacturing many preparations from indigenous raw materials.

The Medical Stores Depot Bombay has, for many years, supplied to the Indian Medical Stores Department surgical instruments and appliances. A private concern has now established a factory which undertakes manufacture and repairs of all instruments and appliances. The articles turned out are of excellent workmanship and finish, comparing favourably with articles manufactured by the best known surgical instrument-makers in England. War demands have led to many new developments, including the manufacture of artificial limbs.

Glassware for laboratories such as petri dishes, litre-flasks, glass tubing and test tubes of reasonably good quality are now being turned out and it is hoped that eventually most of India's requirements in this line will be manufactured within the country.

Rubber goods are required in large quantities and in various forms. Owing to their perishable nature a considerable loss is incurred. It is hoped that the Colombo Rubber Mills, a firm of rubber manufacturers lately established in Ceylon, will now look to this line.

A great number of enamelled iron articles is also required. These will shortly be manufactured in India by an English firm at Calcutta.

About medicinal preparations something has been said elsewhere. Oxygen is compressed in cylinders for issue to hospitals. Field dressings are now being made at Madras at the rate of 1000 per day. Bandages are obtained from Indian jails, absorbent cotton wool from Messrs. Sasoon & Co., Bombay and Messrs. Andrew Yule & Co., Calcutta and cottons and gauzes, medicated and compressed from private firms in India.

Operation room furniture, water bottles, brass pestles and mortars, basins, aluminium measures, formerly imported are now obtained from manufacturing firms in India. Trial orders for various descriptions of surgical instruments have also been placed with Indian firms.

Mica and Micanite—Mica, mined in India, belongs to the variety known as muscovite, the chief mining centres are :—

1. The Bihar Mica Belt, a strip of country about 12 miles broad and 60—70 miles long.
2. The Nellore District in the Madras Presidency.
3. Ajmere-Marwar, Rajputana—attempts are being made to open up this area.

The Bihar Mica belt is the home of "ruby" mica, while in Madras the predominant colour is green.

Good mica should be uniform in colour, free from all cracks and flaws. It should split uniformly and easily. It should be flat, giving a perfect reflection.

Practically the whole output of mica is exported. No attempt is made to work up the material. The enormous accumulations of waste mica in the different mining centres have not been put to any practical use. The output for the year 1917 was.—

Bihar and Orissa	...	34,137 cwts.
Madras	...	6,059 ..
Rajputana	...	720 ..

Total	...	40,916 cwts.

Mica is chiefly used as an insulator in the different forms of electrical machinery.

Micanite is reconstructed mica. For this purpose small-sized block mica is split into thinnest possible films by women and children with a long, sharp, pointed knife.

The films, then, are cemented together with shellac dissolved in spirit. It is possible to make sheets of any size and with suitable moulds odd-shaped insulators can be prepared. In spite of the raw material and the monopoly of shellac, micaite is only being manufactured in small quantities.

Buttons—Demand for buttons is very large Japan holds a dominating position in the trade, Italy following. Imports for 1915-18 were as follows :—

(Figures in thousands.)

Country of Origin.	1915-16	1916-17	1917-18	1918-19
	£	£	£	£
United Kingdom.	16	20	10	Figures for 6 months only.
France ...	3	10	6	
Italy ...	38	55	27	
Japan ...	77	127	80	
Total (Including other countries.)	138	214	125	61

Many of the buttons imported from Japan are very cheap, such as find favour in the Indian bazars, where cheapness, as a rule, is the primary consideration.

The manufacture of buttons in India is, to some extent, hindered by the prejudice against the collection and the working up of bones, but a number of a very high class mother-of-pearl buttons are now made by small firms in India such as the Tirhoot Moon Button Factory of Champaran. The products of these firms are higher in cost. They find no favour in India, but are readily bought in East Africa and Australia.

The war has assisted the Button Industry by very large orders as the following purchases of buttons of various ma-

materials, made between the 1st April and the end of October 1918, show :—

Cotton	...	...	1,235	Gross.
Leather	...	...	68,896	"
Zinc	...	...	487,362	"
Horn	...	...	64,025	"
Mother-of-pearl	...	...	7,013	"
Brass	...	...	20,572	"
Bone	...	...	25,564	"

These purchases are likely to place the industry on a firm footing, since like so many other small industries in India, one of its chief difficulties has been an adequate supply of capital.

Cutlery—Demand for cutlery before the war was largely supplied by the United Kingdom and Germany. The place of Germany has been taken by the United States and Japan. The figures of imports are as follows :—

(Figures in thousands.)

Country of origin.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.
	£	£	£	£	£	£
United Kingdom,	77	61	52	57	46	Figures for 6 months only
Germany ...	82	23	1	...	...
Belgium ...	12	4	...	...	...
Japan ...	...	...	3	22	31
U. S. A. ...	11	6	13	18	27	
Total (including others) ...	188	98	72	101	107		63

The making of knives of various kinds has always been an indigenous industry, especially in the Punjab. It has always been in the hands of small artisans. During the war they have been made to do much. It will be a great setback

to this promising industry, if arrangements are not made to secure these makers an adequate civil connection. They have made knives, claspknives, scissors and spoons, not only of excellent quality, but comparing favourably in price with the imported articles. These manufacturers stand in need of assistance not only in technical matters but on the business side of the industry as well.

Pruning knives for tea-gardens are being made in Calcutta in sufficient numbers to supply the demand, out of steel supplied by the Tatas.

Brushes—The manufacture of brushes was always an established trade in India even before the war, but it was chiefly confined to the cheaper types of brushes of certain specified kinds, and most of the better class brushes as well as a number of very cheap brushes and brooms have always been imported from abroad as the following figures will show :—

Year.	Value.
1913-14.	£ 43,000.
1914-15.	26,500.
1915-16.	26,000.
1916-17.	48,700.
1917-18.	57,600.

In 1913-14, United Kingdom, Straits Settlements, Germany, Austria Hungary, and Japan were the principal suppliers. Imports from Straits Settlements include a large number of very cheap brooms, made of cocoanut leaves, while cheap brooms made of grass and fibre with thin strips of canes also come from Japan. Imports from enemy countries consisted largely of paint and varnish brushes. The trade of the United Kingdom which supplies most of the high class brushes of all kinds appears to have been very little affected by the war.

Indian manufacturers have been able to turn out *substitutes* of paint and varnish brushes which became scarce, owing to the supplies from enemy countries being cut off. But these are more expensive than imported ones.

The Army and the Railway have taken the whole Indian output and *the brush-making industry has received great stimulus during the war.* A number of small factories which work mainly by hand has come into existence. Brushes turned out have been mainly horse and mule body brushes.

Army requirements want orders to comply with specifications compiled in the United Kingdom in respect of wood and bristles. During the last 3 or 4 years necessity has compelled the acceptance of local woods many of which have proved to be suitable for brush manufacture. The main difficulty is to get proper supplies of seasoned timber. The Forest Department, it is expected, will look to this matter. It is hoped that the specifications for army brushes will be permanently altered so as to prescribe the use of Indian woods.

In respect of *raw materials*, India is, on the whole, well situated. For *bristles* and fibres the Indian manufacturer is also well off. The Indian hog bristle is not so good in appearance as foreign grades, but in its wearing qualities it is much superior, so that it is eminently suitable for army and mills. Production of bristles is not organised well, because it is in the hands of the lowest classes. Pigs are neglected so that they are attacked by lice which irritate them and cause them to rub themselves whenever possible. This spoils bristles. Moreover, in order to get money, they start plucking before bristles are mature with the result that animals suffer considerable pain and bristles are short. The *fibre* used is at present largely imported. Much of it comes from Ceylon, in spite of the fact that it is produced in large quantities in the South and East of India, whence it is exported, the reason being want of organisation and absence of any firm in India to place fibres on the market in a form suitable for use by brushmakers.

Other things required for the manufacture of brushes are varnish, glue, wire etc. All these have been imported. Since the war Indian-made *glue* has been utilised; but it is inferior to the imported article. *Varnish* is, at present, made by the brush-makers themselves, but unless a good indigenous article is put on the market, manufacturers will return to the imported varnish, as soon as its price becomes reasonable. *Wire* used is an alloy of copper and zinc which will probably not be made in India at present. For binding sash tools and paint brushes a temporary substitute has been secured, but it is likely to give way to imported Irish flax again.

Future Prospects—There are only a few firms that are organised on the factory system and use machinery. Smaller firms need advice and assistance in securing machinery and raw materials. All require protection from foreign competition specially when large Government orders are discontinued.

Flax—Numerous experiments have shown that there are possibilities in India for the production of flax on a considerable scale. In the United Provinces, Bengal, Bihar and Assam, the fibre can be grown with profit, even at pre-war prices of the fibre, provided a suitable agency is forthcoming for the extraction of the fibre. One large firm is contemplating the purchase of flax straw from the cultivators.

Sann Hemp—Sann Hemp is a fibre of the same class as flax. It is markedly more durable than jute. Better *canvas* can be prepared of it than of jute. Two large commercial concerns have taken up the matter and one has arranged for the importation of flax spinning machinery. All coarser materials hitherto made of flax, such as hose pipes, belting, canvas and possibly shoe-maker's thread will be made of Sann Hemp. *A new industry is thus likely to be brought to the banks of the Hoogly as a direct result of the war.*

Sann Hemp is a widely distributed Indian crop. It collects atmospheric nitrogen through the agency of bacteria

which attach themselves to its roots. This crop will therefore enrich land and its extension will add to the agricultural resources of the country. Under certain circumstances, the crop may realise the ideal, long aimed at by agriculturists, of combining a green manure with a revenue crop. So far indigo is the only crop which has approached this ideal. The possibilities of sun hemp in this direction have already been recognised by the Indian Government.

Textiles—The purchases made by the Munitions Board amounted to approximately 2 crores of rupees per month in the latter half of 1918.

The whole of the Government requirements in cotton textiles—with the sole exception at the moment of mosquito netting—have been supplied by Indian Mills at an agreed-on percentage of profits. The economies effected by this arrangement have resulted in a very large saving to Government.

Much has been done to standardise the various classes of cotton materials for army purposes and to draw up specifications suited to Indian manufacturing conditions. As an example, it may be mentioned that the revision for the specification of the puggree-cloth allowed of the material being manufactured by every mill in India and resulted in a saving of 10 lacs of rupees per annum as compared with the price which would have been paid in conformity with the previous specification which could only be produced by 3 or 4 mills in India.

During the year past, Indian Mills supplied—

Khaki dyed drill and puggree cloth	...	46,500,000	Yards.
Gray and bleached cloths	...	9,000,000	"
Webbing and tapes	...	49,000,000	"
Cotton tapes	...	11,000,000	Fathoms
Flannelette	...	2,250,000	Yards.
Cotton Canvas Kit bags	...	2,000,000	
Kullas	...	1,000,000	
Sheets	...	500,000	
Pillow covers and cases	...	400,000	
Mattress cases	...	200,000	
Yarn and thread	...	400,000	lbs.