

**DEVELOPMENT OF INDUSTRIES
FOR WAR SUPPLIES**

THOMAS P. J.

S. I. S.

GOVERNMENT OF INDIA
DEPARTMENT OF INDUSTRIES & SUPPLIES

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FOR
WAR SUPPLIES

by

DR. P. J. THOMAS



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This report was prepared by Dr. P. J. Thomas, who was appointed as Officer on Special Duty in the late Supply Department to carry out an investigation into the industries which had been started or were developed to meet the requirements of the Defence Services in connection with the War. Although the report was produced at the instance of the Government of India, the facts and figures given and the opinions expressed in the Report should not be regarded as official.

PREFACE

The instructions received from H. M. Supply were that I should collect relevant facts regarding industries newly started or developed for meeting war requirements. It was also decided that I should first take up the industries in the D.G.S. group and then proceed to Calcutta to study the industries included in the D.G.M.P. group.

2. Although the ultimate object of the enquiry is the post-war rehabilitation of industries, the first step is to gather information regarding the pre-war condition and war-time developments of industries, along with any points on post-war adjustment which could be got from the Directorates. Accordingly I drew up a questionnaire in three parts to form the basis of my enquiries (see Appendix A).

3. My first task was the selection of industries for study. I consulted the D.G.S. in this matter, and with his help, about 45 industries were selected. In order to help me, in this work the D.G.S. called together the D.D.G.'s to a Conference, at which the *modus operandi* of the enquiry was decided on. The D.D.G.'s in their turn called together the Directors under them and explained the nature of my requirements. I then proceeded to gather the data with the help of the Directorates. In some cases, files containing information were handed to me for use; in other cases notes were prepared for me. Many points were then cleared up by personal discussion. I then drew up my own notes and had them checked by the respective Directors. Help has also been received in this work from the C.C.P.(S) and his staff and from officers of Supply Finance.

4. I must here express my gratitude to the D.G.S. and his staff, and to the C.C.P.(S.), for the ready assistance they gave me. While I have received most of my data from the Directorates, any views contained in the Report are my own, and no one else is responsible for them.

P. J. THOMAS.

29th February 1944.

INTRODUCTION

This Report deals with the present position of Indian industries which have lately expanded or have been newly started for meeting war requirements. The information contained in it is drawn mainly from the Directorate General of Supply, Supply Department. The scope of the Report is necessarily limited, because the data available in that Department are confined to such industries and such aspects of the industries as have come into view in the course of the Department's efforts to procure war supplies. However, as nearly all the industries have actively participated in war production—in fact most of them have lately been mainly engaged in carrying out war orders—the Supply Department is in possession of a great deal of information in regard to industries, and its Directorates could gather more, if need arises. There is no doubt that the experience accumulated and the contacts established by the Supply Department will be essential for making plans for the rehabilitation of industry after the war.

2. Many of the developments sketched in this Report happened since Japan entered the war, and because of it. Till then, Japan had been sending to India a variety of cheap consumption goods and her industrialists had been taking full advantage of India as a price market. This competition has been the greatest obstacle to India's industrial progress, and if after the war Japanese imports revive, many of our new industries may be throttled. One fears that the importance of this fact is not as widely recognized in India as it should be.

3. Much of our recent industrial development has been necessarily of an improvised character. When imports ceased or urgent military necessity arose for some essential commodity, contractors or producers came forward and offered to supply the goods or such substitutes as the country could provide. In these circumstances, production had to be undertaken at short notice, sometimes with inadequate machinery and imperfectly skilled labourers, and in many cases high costs had to be incurred. Nor could price be the prime consideration when urgent military necessity compelled the procurement of goods somehow within the country.

4. In view of the above, there seems to be ground for gratification at what has been achieved. As will be clear from the following pages, many of the old industries (*e.g.*, footwear, glass, silk) have greatly expanded, natural resources hitherto lying idle—minerals, chemicals, vegetable and animal products—have been exploited, and a variety of new industries have come into being. Thus the industrial field in India has been greatly widened, a more rapid industrialisation has become possible, and employment has substantially increased. The fact that the consumption of sulphuric acid—generally regarded as a reliable index of industrial progress—has doubled in about two years shows that a large expansion has taken place in industrial production and that progress is not confined to small-scale industries. Substantial additions to industrial equipment have also been made by the installation of plant and machinery made largely at H.M.G.'s cost. Even more striking is the increase in the number of technicians and the spread of technical skill generally in the country. These developments have been largely haphazard; but if proper steps are taken for the transition from war to peace, Indian industry will emerge out of the war greatly expanded, and with greater prospects in store.

5. It may be that the recent increase in industrial production was greatly due to spoon-feeding by the State and the guaranteed market provided by the war demand. It is also true that such conditions cannot continue long after the war. But if proper steps are taken in time for the rehabilitation of industry by utilizing the valuable experience accumulated in this field by the Supply Department, the difficulties of transition can be greatly avoided, and Indian industry can make rapid strides forward. In future, industrialists will indeed have to rely much more on their own enterprise and initiative, but this adjustment cannot be very difficult in an environment of active co-operation between Government and industry.

6. In deciding on suitable action to be taken to foster deserving industries, fuller data are required than is possible in this preliminary enquiry. Only readily available data have been gathered and only the salient features have been dealt with. Obviously the first step is to find out which industries call for special action of any kind. In making any decision on this point, the data gathered here may be helpful. That decision having been made, it will be possible to make more detailed enquiries on such industries as call for greater attention. This would involve local enquiries in industrial centres. Even in this work, the contacts established by the Supply Directorates can be of great help.

7. There is also need for recording recent industrial development for the use of the public as well as of Government. That Indian industry has made some progress lately is known, but the extent, nature and measure of it is not known widely. On the other hand, there is the oft-repeated complaint in political circles that Indian industry has not tangibly benefited by the war. In these circumstances, the early publication of a book on the subject of industrial development in war-time will be of great use in many ways. The present Report can form the nucleus of such a work. The nature of the Supply Department's business relations with Indian industries must also be dealt with, and this will be of great help to the Government when similar situations arise in future. It may be possible to compile such a work while the Directorates of the Supply Department are functioning, but it will become difficult after their disbandment. Hence the urgency of this matter.

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I. WOOLLEN MILL INDUSTRY

I.—TEXTILES

A.—Before the War

The general position of the Industry.—The capital invested was approximately Rs. 2,50,00,000. The number of woollen mills was 15, out of which only 4 were fitted out for making both woollen and worsted cloth. One was purely a worsted yarn spinning mill, putting a small quantity of knitting yarn in the market. The others were mainly woollen mills putting into the market rugs and coarse woollen cloth. The mills never worked all the year round and were mainly busy during the summer months against orders booked for delivery in August and September. The woollen cloth trade in this country was essentially a seasonal one. It would be more or less correct to say that before the war the major units of the industry were working a complete day shift for about five months in the year and for the rest were keeping up a pretence of production. Some of the mills actually remained closed for the balance of the year. A very rough proportion of indigenous production of woollen goods to the volume of imports before the war will be as 1 : 3 by weight. About 1.2 million lbs. of woollen goods were imported per annum on an average during the period 1936 to 1940. Indigenous production may be put at 4 million lbs. excluding hand-spun, hand-woven goods.

Lines of production.—The major units of the industry were making cheaper grades of worsted suitings, hosiery, lohis, union cloth (woollen and cotton), woollen tweeds, broad cloth, flannel and rugs.

Marketing.—The main woollen cloth market was Amritsar, from where distribution was effected. The bulk of the indigenously produced woollen, and worsted cloth was distributed in upper India. There was a small market for lohis in the South.

Centres of production.—The major units of the industry are at Cawnpore, Dhariwal (Punjab) and Bombay. Bombay has six mills and Cawnpore one. Lesser units are located at Bangalore, Amritsar, Srinagar, Baroda and Mirzapur. The power-loom industry is almost completely centred in Amritsar. There are no special reasons why major units were located in the centres referred to. Possibly Cawnpore was chosen because it was already growing in industrial importance. Dhariwal was chosen probably because of its cheap labour and because the main market to be served was in the Punjab. As the major units are dependent mainly upon imported Australian wools, a more rational location for them would have been nearer the ports where in pre-war days not only raw materials, but also fuel (oil and coal) were readily available.

Raw materials used.—All the worsted mills in this country, of which there are four, are dependent upon supplies of Australian wool and tops for their manufacture of worsted cloth and hosiery yarn. The woollen sections of mills use indigenous wools largely for blankets and rugs. It will be more or less correct to say that apart from blankets and rugs, very little of indigenous wools were used in cloth intended for apparel.

Processes of manufacture.—Almost all the machinery in woollen mills is imported from the U.K. Most of the mills had changed to the electric drive

in the year preceding the war. Power was obtained either from a central authority or was generated locally inside the mills.

Nature of labour.—Despite the fact that work in woollen mills was not considered a very congenial form of employment, the labourer in woollen mill was usually paid slightly lower rates of wages than textile operatives in the neighbouring cotton mills. This was possibly because the woollen mill worker never expected to remain wholetime at his job and it suited him to get work for a few months of the year to enable him to return for the rest of the year to his agricultural pursuits. As woollen manufacture was in full swing in the summer months when agricultural occupation was slack, the industry found it possible to recruit its labour for these months at lower rates of wages.

B.—In War-time

When the war broke out the 15 woollen mills in India were invited to undertake production for the Defence Services on a 100 per cent. basis, *i.e.*, entirely cease manufacture of goods for the civilian market. As the terms of payment were on a cost plus profit basis, and as the raw material, *viz.*, wool was controlled by Government, and as there was no prospect of the woollen mills getting wool otherwise than through Government, all the woollen mills readily agreed to go into the production on Government account. Since the beginning of the war to-date, they have been working full three shifts a day, turning out Defence Services goods. The total annual wartime production of all the organised woollen mills is roughly 15 million lbs. Thus the production of the Indian woollen mills has increased to nearly 3¾ times what it was before the war. There was greater standardization in the manufacture of goods for the Defence Services and far fewer lines were needed by Government than the mills were producing for the civilian market. There was a much greater use of the imported Australian wools than used to be the case formerly. The augmenting of production was secured by working more shifts on the existing plant and machinery. Very little additions to plant and machinery have been made since the start of the war. All the additional labour both skilled and semi-skilled was located and trained in a very short time. Capital was advanced by Government for the purchase of raw materials.

Two new mills for producing blankets were started in 1943: one at Allahabad and another at Bangalore.

So far as the woollen industry is concerned, it cannot be said that new lines of production have been established. What has been done is merely to divert existing capacity to suit the requirements of the Defence Services.

The following were the chief articles produced in 1943:—

Serge, service dress	..	..	..	..	2,575,070 Yds. (56" wide)
Shirting, Angola Drab	..	..	..	..	3,564,000 Yds. (30" wide)
Cloth, Drab Mixture	..	..	..	..	1,362,660 Yds. (56" wide)
Flannel, Silver Grey	..	..	..	..	2,600,530 Yds. (54" wide)
Heavy Union Flannel	..	..	..	..	7,200,000 Yds. (30" wide)
Overcoating cloth of various kinds	..	..	..	..	675,070 Yds. (54" wide)

The mills have so far been precluded by agreement from catering for civilian demand. Owing to the consequent scarcity and high prices of woollen cloth in the civilian market, it has now been decided to release part of the production for the civilian needs. Slightly over 25 per cent. of the mills' production will be released in 1944. This will be distributed under the supervision of the I. and C. S. Department. This is the first step in the readjustment of the industry to normal conditions.

C.—Post-war Adjustment

The entire output of the woollen mills now going into war orders can, if suitably changed as regards construction of cloths and patterns, go into civilian markets after the war. The absorption potential for such goods in this country is sufficiently high to take off the entire output. We are not at all dependent upon an export market for keeping the industry in full production.

One of the main reasons why indigenous goods could not compete with imported lines before the war was the fact that the latter was never an all-wool affair. The enormous amount of the cheaper types of woollen goods imported into this country from Italy, Poland, Germany and Japan was composed of waste wool, wool reclaimed from old garments and fibres other than wool, whereas the Indian mill industry prided itself on producing pure wool stuff from all-virgin wool. Fortunately the production of goods for the Defence Services during the war has left on our hands an enormous quantity of woollen wastes. It will be to the interest of Government to insist on the re-use of these wastes by admixtures with pure wool in post-war production. If this is done systematically and under compulsion if necessary, and if the necessary preparatory machinery is ordered out, then there is no reason why the products of the Indian mills should not be able to compete successfully with imported lines.

There should be a re-allocation of plant. Worsted machinery can most advantageously be located at or near ports, as mostly imported Australian wools are used. Woollen machinery which can use Indian wools to a large extent should be located in territories where the products are mostly consumed. This will apply only to any new plant that is proposed to be set up. On the whole, however, the existing location of the woollen mills in this country cannot be improved upon, taking all circumstances into account.

Large scale additions to machinery except by way of replacement of existing plant may not be necessary, unless it is proposed to take advantage of a promising export market. It is, however, very doubtful whether India will enjoy any special advantage in an external market, so far as woollen goods are concerned.

At the moment the industry possesses the necessary technical personnel and labour to enable it to work at optimum production level, and there should be no difficulty in finding replacements of labour wastage.

It may safely be presumed that there will be no difficulty in getting an adequate supply of raw materials especially Australian wools in the post-war period. Large quantities of Australian wools were bought by Japan and there is no reason why India should not be able to buy in the Australian market her needs of wool for the increased production now contemplated.

Rationalisation of manufacture has to be brought about among the woollen mills in India. A marketing organisation may help to allocate orders among the several mills on the basis of lines best suited to each. A Federation of Woollen Manufacturers in India has been established since the start of the war and the Supply Department has been negotiating contracts with this Federation. The Federation can continue to perform very useful functions in relation to the whole industry in the post-war period by taking up for discussion and decision questions regarding rationalisation, marketing, etc.

2. WOOLLEN (WORSTED) POWER-LOOM INDUSTRY

As has happened lately in the case of the cotton textile industry, small power-loom establishments have come to operate in the woollen manufacture also. Most of them are at Amritsar, where there are about forty concerns operating power-looms, about 850 in number. There are also many other smaller concerns in the same town.

Prior to the war, these power-looms had been using worsted yarn imported from Japan (except two concerns in Amritsar, which had their own woollen spinning plant, sufficient only for their own requirements of yarn). Using such yarn in conjunction with cotton yarn, they produced shirtings, light-weight suitings, shawl cloths, serges, etc. for the civil market. The majority of these cloths were produced on narrow width looms. There are only a few broad looms in Amritsar.

Since the outbreak of war up to the middle of 1942, the power-loom weavers of Amritsar had to remain idle for want of imported yarn. They were then invited by Government to weave flannel shirtings for the Defence Service from imported worsted yarn, for which arrangements were made by Government. Such yarn was given to them against specific fabrication contracts. Besides making flannel shirtings (at the rate of 300,000 yards per month, consuming 100,000 pounds of yarn), they also made worsted and woollen serge, worsted line fabrics, etc. Only part of the weaving capacity available in Amritsar has been used in this way, one of the principal reasons for this being the limited capacity of the dyeing and finishing plant available in the locality suitable for correct processing of worsted cloths for the requirements of Defence Services. A large number of concerns have no dyeing and finishing plant whatever, and in peace-time are engaged in the weaving of cotton cloths, which require little or no after-processing.

As for the future, steps will have to be taken to ensure an adequate supply of worsted yarn. There is sufficient capacity in the worsted mills to meet the needs of the Amritsar weavers, especially in regard to union yarns. In all probability, Amritsar may establish its own spinning plant to feed its looms.

3. WOOLLEN HAND-LOOM INDUSTRY

A.—Before the War

The woollen hand-loom industry formerly supplied a great deal of cloth in Northern India, but with the change of fashions, mill-made fabrics became more popular, Tweeds and puttoo cloth made on the hand-loom continued to be in demand, but the competition from the shoddy fabrics from Italy and Poland before the war had hit them very much. Thus the hand-weavers came to confine themselves largely to the making of coarse blankets (Kambli) made from unscoured wool, and there was a large seasonal demand for them from the poorer classes, who used it as a mackintosh, blanket or travelling rug according to necessity.

Woollen hand-weaving is widespread in the Punjab, U.P., Kashmir, and in parts of Bombay and Mysore. The conditions of this industry are allied to those of the cotton hand-weaving industry, on which the Fact Finding Committee (Hand-loom and Mills) prepared an elaborate report for the Government of India in 1942.

Another section of the hand-weaving industry confined itself to the making of carpets and durris. This is also an old-established industry,

spread over the Punjab, Kashmir and Madras. In several areas, this industry is largely subsidiary to agriculture, cultivators making carpets in the off-season. The principal centres are Mirzapur, Amritsar, and Srinagar in the North, and Bangalore and Ellore in the South. Before the war, the well-known Mirzapur Carpet industry gave employment to a large number of persons in and around Mirzapur, and the carpets made there found a ready sale all over the world.

B.—In Wartime

At the outbreak of the war, the Army's demand for barrack blankets was enormous and far in excess of the mills' productive capacity. It was, therefore, decided to encourage the hand-loom industry to produce blankets for the Army. The hand-loom production of blankets at that time, however, was in undeveloped state and, apart from the small production of blankets in the Panipat area of the Punjab and Muzaffarnagar in the U.P. there was no other organised production centre. In 1940, a conference was called by the Supply Department at New Delhi at which the Provincial Governments and States were represented, and a scheme was prepared for developing the hand-loom industry were to continue in production, they should manufacture U.P., Punjab, North-West Frontier Province, Patiala State and other Provinces and States. By 1944 the production from all these areas was considerable, being about a million blankets per annum. In 1942, in an effort to increase production, the quality of blankets supplied by the hand-loom weavers deteriorated to such an extent that the C.G.I. insisted that if the hand-loom industry were to continue in production, they should manufacture blankets of a superior quality. This change resulted in a fall in the output of blankets, and several Provinces and States were unable to produce a blanket which was acceptable to the C. G. I. In 1943, it was estimated that the total quantity of blankets received from the hand-loom industry, was only about 250,000, the bulk of which having been produced by the U.P. Industries Department.

The policy in regard to the utilisation of the hand-loom industry for Defence Service requirements is still under consideration. In view of the general inability of this industry to manufacture a blanket suitable for Army requirements, the C. G. I. had indicated that any quantity which could not be manufactured in India by the woollen mills should be obtained from overseas. It was, however, pointed out to the C.G.I. that at least in two Provinces, good quality blankets are now being produced. As a result of recent discussion, it has been decided to place orders with the hand-loom industry in 1944. It is estimated that during 1944, the U. P. Industries Department will be able to manufacture approximately 40,000 to 50,000 blankets per month and the Patiala and other Punjab States above 300,000.

A suggestion has been made that in the event of the Supply Department being unable to place orders for hand-loom blankets for supply to the Army, the capacity released should be utilised for the manufacture of blankets for civil consumption. It should be noted, however, that unless the price of the blankets is reduced to approximately Rs. 5 to Rs. 6, the prospects of being able to find a ready sale for this type of blankets would be extremely remote. The price that the Supply Department is paying for any blankets is between Rs. 9 and Rs. 10 each.

It will be obvious from the above notes that the hand-loom industry has benefited greatly from demands for the war, but it is extremely doubtful whether it will be able to manufacture goods for civilian consumption at competitive prices during the post-war period.

With regard to the method employed by the suppliers to obtain blankets, it should be noted that apart from the Director of Industries, U.P., who deals with the weavers direct, the other suppliers deal through contractors.

Other hand-loom woollens.—Considerable quantities of hand-woven cloths have been purchased by the Supply Department from Kashmir State since the outbreak of war. These cloths, however, were purchased as substitutes for Defence Service materials, and as Army demands have now been considerably reduced and the standard material have become available from the mills, purchases from Kashmir have ceased. The type of cloth which was being purchased from that area was puttoo and tweed, the former being utilised for lining cloth and at one time puttoo dyed khaki as a substitute for serge Service Dress. At the moment, it is understood that the Kashmir weavers are having no difficulty in disposing of their production of tweeds and puttoo cloth in view of the great shortage of goods for the civilian market due to the mills in India upto the end of 1943 being engaged a 100 per cent on Defence Service requirements.

During 1944, it has been agreed that 25 per cent. of the mills capacity will be released for civilian consumption, to be controlled by the I. & C. S. Department. It is possible that this will have an adverse effect on the hand-loom production; at any rate, it may result in a reduction in the high prices now being enjoyed by that industry for tweeds and puttoo.

C.—Post-war

With regard to the post-war period, in so far as Kashmir State is concerned, there is reason to believe that if the Kashmir weaver confines himself to making good quality hand-woven tweeds, there will still be a market in India for this industry, which should have benefited to some extent from the education it has received in producing better quality tweeds for the Supply Department during the war.

The position regarding the production of hand-woven blankets after the war is, however, extremely doubtful, as attractive cheap mill-made woollen blankets will again be put on the market. It is for consideration whether a subsidy or any other assistance should be given to the hand-weaving industry.

4. WOOLLEN KNITTING INDUSTRY

A—Before the War

Four of the woollen mills have their own knitting sections; two of them are in Bombay, one at Cawnpore and one at Dhariwal. Their knitting capacity is fairly large, but only part of this capacity has lately been utilised, as some of it is for fancy knitting which cannot be easily switched on to the kind of ordinary standardised production required for Army purposes. Nevertheless production has been considerable, as can be seen from the figures given below:—

					Annual production
Socks	..	..	..	..	4,752,000 pairs.
Stockings	..	..	..	..	300,000 pairs.
Jerseys	..	..	..	..	756,000 garments.
Vests	..	..	..	..	504,000 garments.
Drawers	..	..	..	..	384,000 garments.

There is also in the country, especially in the Punjab, a small scale knitting industry, using power machines as well as hand machines. The largest centre of the industry is Ludhiana. There are also knitting concerns at Lahore, Jullundur, Rawalpindi, Cawnpore, Lucknow, Bombay, Ahmedabad, Calcutta and other places.

The knitting industry has been called "hosiery industry", indicating thereby that the bulk of knitting done is in hosiery. The smaller concerns are still engaged in the knitting of socks, caps, mufflers, etc., but the larger ones, worked with power machines, turn out pull-overs, slippers, coats and similar articles. Before the war Japanese competition was very active in this latter class of goods.

The yarn used was largely imported from abroad, especially Japan, and only a small portion of it came from Indian mills. Some hosiery factories in Bombay and Ahmedabad had been using yarn from Indian mills. As the demand for woollen goods is seasonal, the knitting industry used only part of its capacity to make woollen goods, and only for 4 or 5 months in the year; for the rest of the year many of them made cotton hosiery.

At first the machinery came from abroad, but gradually Ludhiana has come to manufacture a large number of them.

B.—In War-time

As in the case of the power-loom weavers, but to a greater degree, the woollen knitting industry is now employed by the Supply Department for the production of socks, stockings, jerseys, pull-overs, vests and drawers; all from woollen yarns provided by Government. In 1941 only 10 concerns which were then in possession of machines of the requisite coarse gauge for woollen garments suitable for Defence Services, were employed for this production. Since then many other concerns have been included in the Supply Department's scheme, and at the present moment there are some 42 such knitting concerns of various sizes. Of these 30 are in the Punjab, 5 in U.P. and the rest mostly in Bombay and Delhi. The monthly production capacity has greatly increased. It is approximately as follows:—

	Monthly production
Socks and stockings	1,000,000 pairs.
Jerseys	225,000 garments.
Vests	100,000 garments.
Drawers	100,000 garments.

In Ludhiana, which is much the largest centre of this industry, there are numerous knitting factories, some of which employ several hundred persons. Not all of these have been made use of by the Supply Department, partly because of the limited demand and partly because some of the concerns are not in possession of machinery of the requisite gauge.

As mentioned above, the bulk of the worsted yarn used in peace-time for this industry was imported from Japan, and large stocks of this were in the country when hostilities with Japan commenced. Even now there are some stocks remaining, but these are rapidly being consumed. Yarn now imported by Government is from Australia and U. K. A small portion comes from two mills in Bombay.

C.—After the War

Many of the knitting machines have been adjusted to meet war requirements. The knitting equipment is simple and can easily be adjusted to meet the civilian requirements. Not much extra capital will be required for this purpose. They could continue their production if the market is found and if they obtain adequate supplies of yarn and needles. For both yarn and needles, the industry is mostly dependent on outside sources.

It is probably correct to say that the cheapest woollen garments available for the cold weather are those produced on knitting machinery, and provided these could be produced in sufficient quantities at reasonable prices,

a market will exist for very large quantities of cheap woollen outerwear, such as jerseys, slippers, cardigans, etc. But the knitting departments of the mills can meet a good portion of this demand. In addition, it should also be noted that the woollen mills have batteries of knitting machines suited for the fancy civil trade, and these machines are being kept idle during wartime. When their work is resumed after the war, it is doubtful if the small-scale knitting industry will be able to capture a sufficient share of the civilian market so as to employ all their present capacity.

The availability of cheap yarn is an essential factor. Formerly yarn imported from Japan at low prices was maintaining the industry. Will such yarn imports be revived and will their prices be as favourable as formerly? Another source of yarn will be Indian worsted mills. Will these mills manufacture worsted yarn in excess of their own consumption so as to feed the small knitters? Even if they produce yarn, will it be sold at such prices as will enable the small knitters to compete with the knitting sections of the woollen mills? These are some of the questions which have to be answered before the small knitters' prospects can be assessed.

Assuming that wool will come duty free, while yarn will have to pay a duty, the knitting section of Indian mills may be able to get yarn cheaper than normal imports of yarn and thus will be able to compete successfully with the small knitters. Similar problems have arisen in the case of other branches of the textile industry also. Whether this section of producers deserves special protection and if so in what form is a question to be calmly considered.

The small knitters had been formerly dependent not only upon imported yarn but also on needles which came chiefly from Japan and Germany. At the present moment, Government, is importing needles for the section of the industry which is engaged in the production of Defence requirements and since the production of knitting needles is a highly technical and complicated business it is likely that the industry will continue to be dependent on supplies from abroad even after the war.

In case knitting industry cannot be given an adequate market for woollen goods, it may have to do cotton knitting during the greater part of the year, as it had been doing before the war.

5. SILK INDUSTRY

A.—Before the War

There was formerly a flourishing silk industry in India for supplying garments and fabrics for upper class requirements and for exports on small scale. After the last war the imports of raw silk and silk materials from China and Japan created a severe competition for the Indian silk industry. Even more injurious was the competition of artificial silk which owing to its cheapness became popular among the poorer classes. The production of genuine silk thus declined and the use of imported art silk increased instead. According to the Tariff Board Report (1940) there were 105 silk weaving establishments in 1937, employing about 4,700 workers, but the great majority of them used imported silk. As a result, the sericulture industry (which produces the raw material) fell on evil days. The production of raw silk by the charkhas continued, and even in 1937 their total production was estimated at about 6,00,000 lbs. This silk was used mostly by handloom weavers for the manufacture of saris, shirtings and other garments.

High quality raw silk from Kashmir and Bengal silk saris and other fabrics from Mysore, Bangalore and Bengal, including Endi silk of Bengal and Muga from Assam had a flourishing trade at one time.

B.—In Wartime

In 1941, when the Government decided to make parachute cloth, an anxious search was made for silk components for this purpose (silk fabric, cord, tape, thread, etc.), Genuine silk was essential for this purpose, but was not available in India in any considerable quantities. Most of the genuine silk was spun on the charkha, but this was not suitable for precision work of this kind required for parachutes. There was some quantity of it in Kashmir and Mysore, but it was too meagre. The preliminary work in connection with the manufacture of parachute components was undertaken by the C. G. I. at Chhoi Silk Mills, Bombay. Later the Supply Department took it up.

As a result of conferences held in August and September 1941 (attended by Provincial Directors of Industries and Directors of Sericulture), it was decided to start a Government Parachute Factory and to develop a pure silk industry in India, to make parachute components. To meet the immediate demands in 1941, about 300 tons of Iranian cocoons available in India were purchased and given to Kashmir filatures for reeling.

The first order for the manufacture of parachute fabric was placed with Chhoi Silk Mills, Bombay. The Bengal Silk Mills and the Swadeshi Industry, Ltd., Calcutta, also undertook the manufacture, under the supervision of the Director of Industries, Bengal. Subsequently orders were placed with mills all over India including the Kashmir Government Factory and the Mysore Government Factory. In Madras the orders were placed with small weavers but most of them were not able to supply the proper material.

The Government of India agreed to supply raw silk to H. M. G. and the latter undertook to share in the cost of the scheme for the expansion of production of raw silk in Bengal, Madras and Mysore. Accordingly in 1942, with the co-operation of H. M. G., a scheme was initiated to increase the output of filature silk suitable for parachute manufacture involving the installation of about 3,500 new basins in the three main silk producing areas of India mentioned above. (Kashmir having already a well-established silk reeling industry owned by the State, it was not considered necessary to include that State in the scheme.)

For fabric manufacture, trial orders were placed with 35 silk establishments scattered all over India. Of these only one firm in Bengal, two in Kashmir, two in Bombay and the Government Factory in Mysore were able to supply a satisfactory fabric. In the manufacture of parachute heavy cord, one firm in Bengal and one in Bombay and two in Mysore proved satisfactory.

In Madras, the Government undertook, as a part of the scheme, to arrange for the erection at Kollegal of 500 basins capable of producing 150,000 pounds of reeled silk in a year. These 500 basins are being set up at the cost of H. M. G. and Government of India, and will be the latter's property. At the termination of the contract, the Government of Madras will assist in disposing of the filatures at the best possible price, but will not be responsible for any loss. The contract with Madras Government is for a period of 3 years, with a modified Break Clause. In Bengal arrangements were made for setting up about 1,500 basins by private persons, with the financial assistance (loans) of the Government of India. All the silk produced will be sold to Government of India at controlled rates, and the contract is for the duration of the war and a year thereafter. In Mysore, the filatures will be partly under State management and partly under private management. 200 basins at the State-managed filatures at Kankanali are

being constructed at the expense of H.M.G. and Government of India, and Mysore Government may take over these at the end of the contract at prices to be fixed at the time of sale. The produce from these filatures will be sold at cost to Government of India. Private concerns are being granted loan by the Government of India, on the guarantee of Mysore Government. Their entire produce of raw silk will be sold to the Central Government. In this way Mysore proposes to set up about 1,800 basins.

In 1943, the outturn of raw silk produced in Kashmir (from Iranian cocoons and their own cocoons), Mysore, Bengal and Madras came to about 3,00,000 lbs. All this was used in India. The estimated production for 1944 is 6,00,000 lbs. It may go up to about one million pounds in 1945. A portion of this will go to H. M. G. In addition, there will be very large quantities of charkha silk.

In order to improve the quality of raw silk, it is essential that the silk produced should be tested in properly equipped 'silk conditioning' houses. One fully equipped conditioning house has been established in Calcutta, and two others are proposed to be set up, one in Mysore (Chennapa) and another in Kashmir (Srinagar). The machinery does not raise any complicated problem. The reeling machine is simple. They were formerly imported from abroad, but are now being manufactured in India. The looms and reeds present a bigger problem. They are now imported, but attempts are being made to make at least parts here, and thereby to obviate the need for dependence on imports.

For increasing the production and supply of disease-free eggs of suitable strains in connection with the efforts for the extension of silk cultivation in India, as well as for the prosecution of research work in the diseases of silk worms and mulberry, a Central Sericultural Station has been set up at Berhampur (Bengal), with a sub-station at Kalimpong (Bengal) by Government of India (Department of Industries and Civil Supplies in consultation with Supply Department).

In November 1943, two experts were obtained temporarily from England to advise the Government of India, one on silk-reeling and the other on parachute cloth weaving. They have toured the country and have assisted mills and filatures with suggestions for improving reeling of filature raw silk and for weaving parachute cloth.

Thus an industry of great importance has been newly established.

C.—Post-war Adjustments

After the war, silk may be in demand for parachute manufacture, as it is likely that paratroops will be maintained as a permanent weapon of Defence. A certain amount of silk, mostly spun silk, will also be required for Cordite and Munitions factories. The civilian demand has always been large in India, especially as silk garments are prescribed for certain occasions and for certain cases of persons (*e.g.*, widows garments). With the rise in mass purchasing power, the demand is sure to increase. The survival of the Indian industry will depend upon its capacity to compete with imports after the war. If proper steps are taken, Indian raw silk will be able to stand the competition from Japan, which formerly held the palm for silk.

As for adjustment in manufacture, it will not raise any great difficulty. Some of the fabrics now made for parachute purposes can be used for garments. The fabrics, 36 inches wide, may be used for shirtings and for ladies and children's wear. To suit the civilian demand the width of the cloth may also be increased by a slight adjustment in weaving.

6. CLOTHING INDUSTRY

A.—Pre-War

The production of clothing as an industry does not exist in India. So far it has been only a Defence Industry, maintained by Government. Prior to World War I, there were two permanent clothing factories (Alipore and Madras) whose combined monthly output was about 40,000 garments: but war demands necessitated the establishment of about 18 temporary or branch factories more. After the war, these temporary factories were closed down. By 1931, only the Shahjahanpur factory remained working, with a monthly output of about 75,000 garments. But the factory was capable of expansion, with its existing peace-time buildings, plant, equipment, and staff, to at least six times this output, at a two shift basis. Apart from this single Army Clothing Factory, there were, on the outbreak of this war, two others of smaller size owned by the Railways, the North Western Railway Clothing Factory at Mughalpura, Lahore, and the M. & S. M. Railway Clothing Factory at Perambur, Madras. There were besides, a few firms producing clothing on machines. Much of the clothing required by Railways, Posts and Telegraphs, Police, dockyards, shipping companies and large industrial concerns was produced by durzie contractors or "Thekadaras", working in large cities like Calcutta, Bombay, Madras and Lahore. Many firms in these cities had developed before the war, a considerable clothing export trade with Burma, the Far East and Africa, by canvassing for orders and producing the goods, through the agency of contractors who employed individual durzies. The general demand for clothing of the civil population was, however, largely met by independent tailors, working in their own establishments.

B.—War-time

The heavy demand for clothing for Defence Services necessitated the large expansion of the industry. The Shahjahanpur factory has been expanded, and temporary factories have been established at Lahore, Madras, Bombay, Calcutta, Agra, Sialkot, Delhi, Secunderabad and Ahmedabad. In addition to clothing, parachutes are also being produced at Cawnpore and Lahore. The Sialkot and Lahore factories are going to be engaged solely on the production of parachutes. Thus there are now nine clothing factories and three parachute factories. Of these, only the Shahjahanpur and the North Western Railway Clothing Factory at Lahore and the three parachute factories at Cawnpore, Lahore and Sialkot have any internal tailoring production. All the others are purely 'cutting contract' factories, that is, these factories limit their production activities to 'cutting', and the cut garments are given over to contractors for fabrication or making up into clothing. The process of cutting is undertaken through the medium of Bank knife cloth cutting machines, run by power, and by election cloth cutters. In the production factories, all tailor work is done by Singer Sewing and specialist machines on benches driven by power, a bench of 30 machines requiring a four H. P. motor. Tailoring done by contract is usually on treadle sewing machines or by hand machines, though some of the larger contractors have a few machines driven by power.

The raw materials for these clothing factories comprise cotton, and woollen textiles, sewings, buttons, buckles, etc.

The towns in which the clothing factories have been established have a plentiful supply of tailor labour. Towns in the Punjab and U.P. are more favourably placed in this respect than Madras and Calcutta. This factor, rather than the proximity of the towns to the sources of supply of raw

materials, has led to the establishment of the factories in the above-mentioned towns.

The total output of clothing for the year 1942-43 was about 120 million articles, or a monthly average of nearly 100 million. This is more than 100 or 120 times the peace-time output of the Shahjahanpur factory.

C.—Post-War

The army demand for clothing will dwindle after the war, but the plant and machinery in the factories can be switched on to practically any other type of clothing production. But unless civilian and Government demand for factory made clothes increase, there will be unemployment among a large number of technical and non-technical staff. Most of the technical staff thrown out of work will probably open their own small tailoring and outfitting establishments, and the non-technical unemployed could be absorbed in other industries.

But the clothing industry deserves to be developed in the post-war period, for factory-made garments are more durable than those supplied by the contractors and the demand of the Government Departments, Railways, and big industrial firms will be of sufficient magnitude to warrant the establishment of at least three or perhaps four permanent factories in peace-time. The workers will also be benefited by the development of factories, for the factory worker is better housed, and better paid and works in more sanitary surroundings than the employees of a contractor.

In most countries, there is a well-established clothing industry supplying standardized clothes to the civilian population, and even new countries like Canada and Australia are exporting such clothes.—One clothing factory, in Leeds (Montague, Burton) employed 11,000 persons before the war. In spite of the endless variety of costumes in India, there are items of apparel which can be produced on a standard pattern in clothing factories. Thereby much waste of cloth and material can be avoided and clothing can be supplied cheap. It is hoped that private capitalists will come forward and take over some of the army clothing factories with all their equipment and run them as private concerns, thereby giving steady employment to tens of thousands of persons who are now working in clothing factories. The workers in these factories number about 100,000 excluding supervising or casual labour who may be fourth of that number. This would cheapen clothing and would be of great help to persons of the lower and middle classes. The technical and supervising staff of the existing factories can also be utilized to great advantage in building up this new industry.

II—LEATHER INDUSTRY

Introductory

India has long had a prominent place in the world's production of hides and skins. Having a third of the total cattle of the world (250 million cattle besides 48 million sheep and goats) India has long been the world's largest supplier of hides and skins. India's output of this commodity was estimated at about 21 million cow hides, 5½ million buffalo hides and 25 million skins (goat, kid and sheep). One peculiarity of the Indian hides and skins supply is that it was liable to fluctuation from year, to year, as nearly three-fourths of the cattle hides are from animals which die a natural death and not from slaughtered cattle as in other countries. Thus the supply increases in years of famine and epidemics and diminishes in prosperous times. India stood first in the matter of cattle hides, and the U.S.A. came second. In respect of goat and kid skins, China has long been the leading supplier.

As much as 40% of our cattle hides and 55% of the skins had been exported before the war. A portion (nearly half) of the cattle hides was exported in a half-tanned condition (East India Kips), and this maintained a large industry in Southern India, which used up 32% of the total cattle hide supply of India (8.6 millions out of 26.7 million hides. -

War has brought about a great advance in the manufacture of leather and leather goods in India. Owing to the tremendous expansion of the Indian Army and the adoption of India as the base of operations against Japan, the Defence demand (both for India and the Allies) for foot-wear and for harness and saddlery has increased to large proportions. Before the war India's consumption of modern footwear was not large for its teeming millions, and part of this was met by imports, chiefly from Czechoslovakia. In 1939 foot-wear numbering 450,000 pairs (valued at about Rs. 10 lakhs) was imported, and 70% of this came from Czechoslovakia; of the rest, Japan sent a large number (mostly rubber-soled shoes). When imports drastically diminished, not only the civilian demand but also a colossal order for Defence purposes had to be met. The prewar army demand for foot-wear came to only about 1,00,000 pairs per annum; the order for 1942 was for 5.9 million pairs and for 1943, 6.6 million pairs. This involved a sudden expansion of the industry, and of the two large units which shouldered the burden, Messrs. Cooper Allens Ltd. has become the largest self-contained foot-wear producing factory in the world. At the same time, the demand for harness and saddlery and other army equipment increased tremendously. The Government Harness and Saddlery Factory at Cawnpore had consequently to increase its employment nearly ten-fold. Private manufacture also got a great and splendid chance. In this way India has come to use up the bulk of its hides and skins, and its leather manufactures have become one of its front-rank industries. Not less than 200,000 workers are employed in the organised part of the industry alone, not to speak of the numbers of the village chamars and the small artisans plying their trade in towns. Eventually, this may take a place next only to the textile industry.

The term 'leather goods' comprises the whole range of articles made wholly or partly of leather. The chief of them are footwear, harness and saddlery, belting, straps of various kinds, boxes, cases, etc. The first two, namely foot-wear and harness and saddlery are the most important of these, especially in war-time. The recent increase of production has been chiefly in these two lines and we shall deal with them separately. As leather is the base of all these goods, the conversion of hides and skins into leather by tanning is the basic industry. Therefore we will deal with tanning first, and then go on to the principal branches of leather industry, foot-wear, harness and saddlery, and the subsidiary trades connected therewith.

7. TANNING

A.—Before the War

Out of about 26 million cattle hides annually supplied in India before the war, 17.6 per cent. was exported raw, and 4.5 per cent. was used by village artisans for making ropes, etc., from hides in a raw condition without any tanning. Thus there remained 20.8 million tons to be tanned under different processes.

There were three chief methods of tanning in vogue, namely (a) village tanning by the indigenous method, (b) kip tanning by the somewhat larger tanners for making dressed hides, largely for export to Great Britain and (c) modern tanning, turning out fully finished leather. The proportion of

the total annual supply of hides used in the various processes is shown below:—

Method of tanning	No. of Hides (Millions)	Percentage to Total
Village tanning	9.1	43.8
Kip tanning	8.6	41.3
Modern tanning	3.1	14.9
	20.8	100

(a) **Indigenous method of tanning.**—This method is carried on in villages by people of certain castes (Cammers, Raighars, etc.). They use certain barks and shrubs in the traditional way. The leather thus produced is not given any finish or colour, and it gives an unpleasant smell which becomes more so during the rainy season. It is generally called 'bag tanning', because the hides are sewn in the form of a bag and tanned with liquor poured inside it. This kind of tanning is going on in all parts of India. One of the largest bag tanning areas is Jullundur district, where the tanning of buffalo hides by this process is done on an extensive scale. Such leather is used for sandals, chappals and other foot-wear common in the countryside and for leather buckets to take water from wells.

As the leather tanned in these crude ways fetched low prices, only hides of inferior quality were used for this process. Most of the hides from dead cattle came into the hands of chamars and they sold away the better ones in a raw state to the *beoparis* and kept only the defective hides for their use.

(b) **Kip tanning.**—This somewhat improved method of tanning was evolved in Southern India a long time ago. The tanning materials used were more or less the same, namely, barks and tanning extracts, but by the use of the pit-tanning method, a far superior material was produced, *i.e.*, soft and pliable leather with no offensive smell. In Southern India avaram or turwar bark has long been used. During the last war this industry obtained a great fillip and as a result, rapid progress was made in tanning practice. This process took a longer time than bag tanning. The use of wattle bark imported from South Africa was found more economical owing to its higher tanning content, and therefore this came to be widely used for tanning cattle hides. The tanning was only half-finished and the leather was uncoloured, but such leather came handy to the British leather manufacturers, and a growing export trade was the result. This process involves no use of machinery and the capital required is small. But there is an advantage in bulk dealings, and business men found it advantageous to carry on such production in fairly large units. Thus around Madras alone, there are 200 such units employing a large labour force. Similar establishments arose also in the Bombay Province and in the States of Hyderabad and Mysore. Hides came from all over India into South, and Madras became the principal centre of this industry and came to be the biggest export centre of tanned hides. The value of the exports amounted to Rs. 6 crores in 1939-40. The bulk of these went to the United Kingdom, where the kips were retanned for utilisation in finished products. As much as 8.6 million cattle hides (or 41.3 per cent. of the total supply of hides) went into this industry and the bulk of this product was exported.

(c) **Modern tanning.**—This comes under two categories—(1) vegetable tanning and (2) chrome tanning.

Owing to the large demand for boots, harness and saddlery for the Indian Army, and subsequently owing to the growing use among the civilian population in towns, of boots and shoes of western pattern, the need for fully tanned and finished leather became gradually important and modern tanning methods came into vogue. A far superior leather was thus produced at Cawnpore, Calcutta and other places, by the use of vegetable materials like babul bark and mairobals.

Chrome tanning has also made progress at the same centres and produced leather for shoe uppers from cow hides. Owing to the use of mineral substances (sodium or potassium bichromate is the main constituent), this process of tanning takes a much shorter time than vegetable tanning, although it involves greater technical skill and closer control.

Vegetable tanning takes from 3 to 6 months according to the class of hide to be tanned and the nature of the leather required. Chrome tanning is a much quicker process, taking only as many weeks as the vegetable process takes months. Each process has its advantages in producing leather for a particular purpose. The vegetable process produces a firm sole leather and a strong harness leather and is suitable for heavy manufactures; while the chrome process produces a soft supple leather suitable for boot uppers and other light works. Chrome leather is used for the uppers of the Army boots, although vegetable tanned leather can also be used for this purpose and this is the main purpose for which the Army requires chrome leather. Vegetable tanned leather is used for almost all other manufactures, *i.e.*, harness, saddlery, belting, boxes, cases, etc.

Of the two classes of hides in India—cow and buffalo hides—the latter are much thicker than the former and are used to produce heavy leather such as sole leather by the vegetable tanning process. Cow hides which are of a much finer texture are mostly tanned by the chrome process for making boot uppers and by the vegetable process for making light harness leather.

Modern tanning is necessarily an organised industry worked in large units on a factory basis. About a dozen of these establishments had adopted chrome tanning and had been using about 2.1 million hides. In Cawnpore and other northern centres, tanneries adopted the vegetable tanning methods more commonly. The Harness and Saddlery Factory at Cawnpore was the most important of these.

Not all the leather thus tanned was used in India. There was also a growing market especially for chrome tanned leather in Africa, Burma, Straits Settlements, Iran and Iraq. After the Ottawa Agreement came into operation, the United Kingdom took large quantities of it, valued at Rs. 54 lakhs in 1937.

The great majority of the modern tanning factories are in Northern India and there are special causes for the localisation of the industry in that part of the country. Some of them are—(i) the greater availability of raw hides (ii) the availability of indigenous tanning material and (iii) the fact that the larger markets for the finished articles are in Northern India.

B.—In War-Time

(a) **Village tanning.**—As the whole of the production of the organised tanning industry is required to meet war demands, the civilian footwear leather requirements have had to be met by leather produced by the bag tanning industry. This has resulted in a very considerable extension of the bag tanning activities. The bag tanner is, therefore, able to give higher

prices and obtain a better selection of hides than was the case in pre-war days.

(b) **Kip tanning.**—During the war years, exports have fallen off for various reasons, whilst the supplies taken by the home market have increased. In 1940 the price of East India kips was fixed by H.M.G. When later general prices went up, the price of hides and tanning material also rose, and it became no longer profitable to produce East India kips at the controlled rates. The exports, therefore, dwindled and large proportions of the kips were absorbed within the country. The Supply Department generally purchasing kips for chappals, etc., for the Army, also found it difficult to obtain sufficient supplies of kips at controlled prices. Therefore, the Supply Department had to raise the price by 2 annas per pound in November 1943. H.M.G. followed suit.

(c) **Modern tanning.**—In order to meet the war-time demands of the Defence Services, the pre-war organised tanneries have increased their production and additional tanneries have come into being the total number being between thirty and forty. The majority of the new tanneries are, however, mainly on a small scale. It is considered that the organised tanning industry has increased its productions of leather by more than 300 per cent. as compared to the peace-time production. This increase has not only been achieved by extension and addition of tanneries but in the case of vegetable tanned leather to a considerable extent by acceleration of the tanning process which has been reduced from approximately six months in pre-war days to three to four months during the war period. This shorter period process was in operation in only 2 or 3 of the larger firms in pre-war days, but has now been extended throughout the whole of the organised tanning industry. This acceleration in process has been carried out without detriment to the quality of leather produced and, it is considered, will be of immense post-war advantage to the industry. (See pages 33 & 35.)

Some of the tanneries carry out both vegetable and chrome tanning. Messrs. Cooper Allens is the largest of them. Vegetable tanning is now centred chiefly at Cawnpore, the Punjab (Wazirabad and Jullundur), Calcutta and Bombay. The centres of chrome tanning are Cawnpore and Madras, the former chiefly supplying the internal market and the latter chiefly supply export trade. In Calcutta, chrome tanning is pursued as a cottage industry by Chinese settlers, but they cater only for civilian requirements.

C.—After the War

Will the new tanneries continue after the war? This will depend on the civilian demand for shoes, boxes, etc., after the war. If the normal civilian demand has increased, as there is reason to believe, the tanning industry will be able to maintain itself to this extent.

8. FOOT-WEAR

A.—Before the War

As in the case of tanning, detailed statistics are not available. Before the war, foot-wear manufacture in India was largely done by village cobblers, mostly to order, and the kind of foot-wear made was largely chappals and sandals. There was a demand for shoes of the modern type in cities and larger towns and this was met to a large extent by the smaller shoe-making concerns as well as by large factories like Cooper Allens. Production, statistics, even for shoes of this type, are not available. A certain part of the internal production of such footwear came from shoe-makers

working in a small way. Machine-made shoes came from a few factories in Cawnpore, Calcutta, and Agra. The chief of these factories was Messrs. Cooper Allens (Cawnpore). Founded in 1881, this firm has had a remarkable development. The daily pre-war production of this firm came to 2,000 pairs. The annual production was about 6,00,000 pairs, and of this 1,00,000 pairs went to the Army. The balance went to meet civilian needs. For this purpose, the firm kept as many as 1,000 agencies throughout India. The other big producing firm was the Bata Shoe Company, Bataagar (Calcutta).

Footwear manufacture (specially machine-made) is centred round Cawnpore, Agra and Calcutta. Such a localisation of the industry was due to the following causes:—(i) These were also centres of modern tanning, (ii) they were suitably situated to meet the requirements of the largest footwear using population of India, which is in the North. Southern India was not much in the picture and had only small concerns.

All over the country especially in towns, a large cottage industry has always been engaged in meeting the foot-wear requirements of the poorer classes. The total production must have been large, but we have no data to assess it.

B.—In War-Time

In war-time, the footwear demand for the Defence Services has had a colossal increase. From a bare 100,000 pairs in the last pre-war year, the supply rose to 3.6 million pairs in 1941, 5.9 millions in 1942, and 6.6 millions in 1943. This increased demand was mainly met by the firms above-named and also by other smaller producing units, some of which were started lately.

Messrs. Cooper Allens have greatly expanded their production. From the pre-war daily production of 2,000 pairs, the firm has increased its production to 19,000 pairs. This tremendous increase has been achieved by—

- (1) working night and day shifts (20 hours a day),
- (2) the standardisation of production, *vis.*, the few types of foot-wear required for the Defence Services as compared to the numerous types required to meet the varied requirements of the civilian population.

It is believed this increase has been achieved without making any considerable addition to machinery, and to a large extent is due to efficient organisation. This firm produces foot-wear from the raw hides to the finished product.

The other large boot producing organisation in India is Bata Shoe Co., whose pre-war production may have been approximately equal to that of Cooper Allens. This firm also has distribution agencies or branches throughout India. It is believed that the Bata Shoe Co. has increased the production during the war period to double that of pre-war days. The majority of their production is for Defence Service requirements.

The production of the machine-made boot entails considerable machinery, most of which is imported from the U.K.

The total pre-war production of the industry was to meet the internal requirements, as at no time has India had an export business in machine-made footwear.

Rubber footwear.—Besides leather footwear, India in pre-war days produced large quantities of cheap rubber footwear. The capacity for production is considered to be in the region of some 12 million pairs annually. Owing to the shortage of rubber, the production of this type of footwear to meet civilian requirements has disappeared and this will undoubtedly have increased the demand for the cheaper leather produced types of footwear.

Once rubber supplies are available, there is no doubt that production for civilian requirements will be resumed, as the rubber shoe is considerably cheaper than a shoe produced from leather.

C.—After the War

That there will be a large reduction in the demand for military boots after the war is certain, because whatever increase India may make in its standing Army and other fighting forces, it will not be of such order as to necessitate the maintenance of the present demand for footwear. There is hardly any difficulty for footwear factories to switch over to the production of civilian footwear. The question then is whether the civilian demand will expand as the Defence demand contracts. In this matter there is some prospect, as will be shown presently (see conclusion).

The Defence demand for footwear has already diminished and it is expected that a portion of the output in 1944 will be released for civilian consumption.

9. GRINDERY

An important subsidiary industry connected with footwear manufacture is grindery, namely, the production of heel and toe tips, eye-lets, nails, thread, etc. These have always been imported largely, because production of an economical size was not possible in India. But when importation became difficult owing to the war, it became essential for India to meet internally her requirements in regard to this item. Therefore indigenous manufacture of grindery was tried from the beginning. The Supply Department made every effort to encourage production. Several firms in Northern India undertook to manufacture grindery and succeeded to making a fair substitute for the imported article. The quality was indeed inferior, but India was compelled to rely on internal production, as it had no other alternative. At one stage, a scheme was prepared for laying a plant for grindery manufacture, but the idea had to be dropped later as the necessary plant was not available from overseas.

The following are the production figures of heel and toe tips:—

Prior to 1941.	Nil.
1941	6,920,000 Pairs.
1942	24,170,000 Pairs.
1943	28,114,000 Pairs.

This is a remarkable record indeed. Attempts were made to obtain a plant from England for making hobnails, but these did not succeed. The future of these subsidiary industries is rather uncertain. As such material is solely for the Army type of footwear, the demand may fall off greatly after the war, and if free imports are allowed after the war, there is not much chance of the industry maintaining itself. As India has neither the plants required for producing grindery on economic lines nor the market capacity to justify the importation of machinery for such production, importation of grindery may be essential. It is for consideration whether there are special reasons why this industry should be safeguarded.

10. HARNESS, SADDLERY AND OTHER ARMY EQUIPMENT

A.—Before the War

Before the war the whole of the Army's requirements of harness, saddlery, paulins, etc., were made in the Harness and Saddlery Factory (Cawnpore), which was equipped for producing the entire range of articles from the raw material to the finished product. The factory has a long tradition behind it and has undergone various changes in organisation as well as in others.

The raw materials of this manufacture are numerous. First and foremost, of course, is leather. The leather used for this purpose is received in the form of 'backs' or 'half backs' (A hide from which the belly portions have been removed is known as 'back'. When the belly portion has been cut off one side only, it becomes a "half back"). In the case of leather the most important part of the work is its cutting to the best advantage. Leather cannot be cut off like a piece of cloth. Certain parts of the hide are more suitable for one purpose than another and the cutter has to arrange his work so that each article is cut from the most suitable part of the hide and that all the leather is used up to the best advantage. The stitching is normally done by the hand, although mainly in the case of lighter class of goods, machine stitching can also be employed.

Next to leather comes a variety of metal components and other materials. The metal fittings are known in trade as harness furniture and they comprise a large variety—buckles, squares, rings, hooks, chains, etc. The saddle tree is made of wood and steel. Webbing is required for the construction of the tree. In the manufacture of paulins, troughs, etc., the chief materials used are canvas which is water proofed in the case of paulins, but not in the case of water holding stores. Web equipment is made on heavy type of sewing machine from specially woven webbing of various widths. The manufacture of this consists of fabricating the webbing and attaching the numerous brass buckles, tips, etc.

Evidently the manufacture of harness and saddlery involved the development of several subsidiary industries and gave employment to a variety of trades.

B.—In War-Time

Owing to the large expansion of the Indian Army and the extended operations of the Allied Armies in India and neighbouring areas, the demand for harness, saddlery, and other army equipment has had a colossal increase. This had to be met primarily by the Harness and Saddlery Factory, Cawnpore, one of the ordnance factories originally established in 1862 as the "Harness Depot". Its recent expansion has been colossal; it to-day employs about 20,000 persons in all as against 3,000 in 1939, and it produces roughly 20 times what it turned out in peace-time. But it was soon discovered that the Army's requirements for this class of goods could not be met without bringing in other sources of production. Therefore in July 1940 an organisation then known as the Industrial Production Organisation was established in Cawnpore to work alongside and in collaboration with the H. & S. Factory in developing trade production of this class of goods. At the inception of this organisation it was realised that on account of the moribund state of the harness and saddlery trade and the fact that the manufacture of goods required called for a higher standard of both workmanship and materials than that necessary for the normal standard of the small bazaar firms, who would be asked to undertake this manufacture, the requisite quantity could be obtained only by having the organisation staffed with practical men to give technical guidance and assistance to these manufactures, so as to educate them up to the required standards and to supervise and control their production from start to finish. Similar action was considered necessary in developing the production of canvas goods and in the manufacture of harness furniture and fittings, the policy in the latter case being to develop production among the small manufacturers whose plant, tools equipment and skill were unlikely to be suitable

for the manufacture of leather stores, but who could be taught to produce what was wanted. The technical staff of this organisation starting from nothing at all and working among these small manufacturers has by practical demonstration built up in various parts of the country a body of some hundreds of contractors who are now successfully producing a large range of articles in big quantities with a degree of skill which they had never before approached and could never have achieved without such help. Large increases in the amount of work made it necessary to expand this organisation from one with a single headquarters in Cawnpore into one comprising 5 Provincial Circles. Under this reorganisation each circle is placed under a Controller of Leather Manufactures, with his Headquarters at a Branch H. & S. Factory which is the centre where materials and components are collected, and stored, leather and textiles are cut and issued to contractors for fabrication, and where the fabricated goods are subsequently received, inspected, packed and despatched to their destinations. Five such circles and Branch Factories have been established: one in Cawnpore itself, adjoining the H. & S. Factory, for controlling production in U.P., one in Calcutta for the Bengal area, one in Amritsar for the Punjab, one in Madras for South India, and one in Bombay.

Each Controller of Leather Manufactures is responsible for organising and controlling the entire production of his circle and for the executive and administrative control of the Branch Factory. The Branch Factory is organised on the same lines as other Ordnance Factories, except that it does not normally carry out any manufacturing process other than cutting. It stores materials and components, cuts the materials into components, and issues the cut leather or textiles together with the requisite metal components, fittings and materials to contractors for fabrication. It plans the work to be done by contractors and maintains the necessary load and progress watching records. It receives the finished work from the contractors and provides accommodation for inspection thereof by the Inspection Section. After inspection the Branch Factory packs the accepted goods and despatches them to their destinations or brings them to stock if they are required for re-issue to fabricators. It also returns the rejected goods to the contractors for rectification and disposal. The Controller also has a technical staff who are responsible for estimating and planning the work and by means of periodical visits to the contractors' premises for giving technical guidance to the manufacturers and supervising and controlling their production.

The manufacture or fabrication work is arranged by means of contracts placed by the Controllers of Supplies each of whom has a purchase staff attached to him. The Controller of Leather Manufactures acts as a Technical and Planning Adviser to the Controller of the Supplies, in regard to the placing of these contracts. He advises the Controller of Supplies regarding the suitability and capacity of particular firms for particular classes of work and assists him with estimates of costs, etc. The actual contract is placed by the Controller of Supplies, and the Technical Staff of the C.L.M. then watches and controls the production under the contract.

The contracts placed fall into two main classes—

(a) Those involving only fabrication from materials and components supplied by Government and (b) Those in which the whole or part of the materials are supplied by the contractor.

C—After the War

The industry is fully engaged in meeting a war demand. The Defence Services demand in future may be more than in pre-war days, assuming that a larger standing army will be maintained. However large this demand may be, a good number of workers will have to be sent away. Many of them are of the shoe-maker caste and they will return to their hereditary profession. Some of the skilled workers may take up the manufacture of harness for the civilian market. Others may make fancy goods like suitcases, leather boxes, etc. Some others may go back to land.

Valuable experience has been gained in the organisation of harness and saddlery production and this will stand us in good stead when similar need arises in future.

Conclusion

While the harness and saddlery production may have to be diminished greatly—the fall has already begun—there is no cause for pessimism in respect of the leather manufactures as a whole. For one thing, there is a world shortage of leather and footwear, and in the immediate post-war years, India with its extensive supply of hides and skins will be able to put this into profitable use, if planned efforts are made in time. Within the country itself, the large civilian population who have had to curtail their consumption in war-time will have a greatly enhanced demand in the post-war years, and this would be all the greater if any active attempts at increasing purchasing power are undertaken. The Indian Army now numbers about two million persons. Many of them were not formerly wearing shoes of the modern type. Assuming that they will now continue to stick to their present type of wear, there will arise a steady demand for footwear and this may employ a large part of the present productive capacity. If in the meantime an export trade also develops *e.g.*, with the countries around the Indian Ocean), India's footwear industry can be one of the biggest in the world. In addition there will be a great deal more demand in post-war years for leather trunks, boxes and suitcases, and various fancy goods. All these will employ a large number of workers.

The small scale or cottage industry has also apparently expanded its production lately owing to the short supply and high price of machine-made foot-wear, but we have no accurate data. When the larger factories turn to the civilian market, small-scale production may have a setback.

III.—CHEMICALS

A.—Heavy Chemicals

Importance.—Chemicals play an important part in modern industry. The major ones among them, *viz.*, sulphuric acid, caustic soda, soda ash, etc. are called "Heavy Chemicals", because their production and consumption are on a large scale. Other chemicals, used on a small scale and therefore produced in smaller quantities, are called "Fine Chemicals". But these latter are more numerous—as many as 4,000 in number—and as will be shown later they are also of vital importance in industrial production, in war-time as well as in peace.

II.—SULPHURIC ACID

General.—Sulphuric acid is the vital basic chemical for almost all industries. From it is produced other important chemicals essential for a variety

of purposes. The consumption of sulphuric acid is, therefore, rightly considered an index of a country's industrial development. There is an extensive demand for it (a) in textile finishing, (b) for filling accumulators (storage batteries), (c) in leather tanning, (d) for picking of iron and steel before galvanising and tinning, (e) for ordnance requirements in the production of explosives, (f) for manufacturing chromic acid required in electro-plating, (g) for non-ferrous metallurgy (*i.e.*, cleaning of brass, bronze and copper sheets and wires). Apart from such use in industrial production, it also enters into the manufacture of other important chemicals, namely, hydrochloric acid and nitric acid (needed for explosives), copper sulphate (required for rot-proofing of jute bags and for insecticidal purposes), magnesium sulphate (required for medicines), ferrous sulphate (required by textiles industry), bichromates (needed for textiles and tanning industries) and aluminium sulphates (required for purification of water supplies, for textiles and for sizing of paper) and above all, for the production of ammonium sulphate and superphosphates which are important fertilizers essentially needed for enhancing agricultural production. In fact, the last named use is much the largest in all economically developed countries; in Russia, for instance, not less than 70 per cent. of the total supply of sulphuric acid goes into the production of ammonium sulphate and superphosphates. That it is far from being so in India, will be clear from the table appended to this note. Out of a total of 73,500 tons produced in 1943 only 19,720 tons went into these two fertilizers.

The chemicals named above as auxiliaries are by-products in the same factory utilizing the surplus acid according to the market demand.

The unique feature of sulphuric acid is that it is to be produced in the area consuming it. This is because the raw material from which it is produced, namely, sulphur, will weight for weight produce three times the quantity of sulphuric acid; the transport of sulphur is thus always more economical than sulphuric acid; this acid, again, is highly corrosive, requiring packing in stone-ware bottles which in turn have to be packed in pent-top (dog kennel shape) cases. The empty space in the pent-top cases has to be packed with earth or cinders to prevent rocking of jaw and spilling of acid. All this increases the weight for transport and considerable wagon space has to be wasted due to the nature of the cases, preventing stocking of one above the other. These difficulties in transportation have thus offered a virtual protection to the industry and encourages its production in India instead of being imported.

A.—Before the War

Production.—There were 23 factories before the war producing sulphuric acid for the market, besides six others producing it for consumption within the factories (see appendix). Most of these were started after World War I, for meeting the requirements of India's growing industrialisation after that war. The localisation of the units will also show that this industry grew as an adjunct to industrialisation in the last twenty years.

Raw materials.—Sulphuric acid is made from sulphur. Iron Pyrites may also be used in countries where it is available. Small quantities of Chilean nitrates (or platinum if by an alternative process) are also needed. Sulphur was imported from Sicily, Japan and Java.

There are two processes used for producing sulphuric acid—(i) the chamber process, the old and uneconomic method and (ii) the contact process which is more economical, neat and compact. Chamber plants have a useful life period of 15 years, after which their maintenance and repair

costs make them unsuitable and unremunerative for competitive production. Most of the chamber plants, except those set up during the present emergency, have outlived their useful period, but are being worked in the present emergency, taxing their capacity to their maximum limits. The prices (which are controlled) are fixed at rates which permit production, badly needed for direct and indirect Defence demands, but include fairly large elements due to maintenance and repairs. The chamber plant requires only a smaller amount of power. Ten-tons-a-day-unit, for example, would require about 15 K.W.H. as against 20 K.W.H. for a contact type plant. The production capacity of the plants existing before the war was 85,000 tons, but only 26,000 tons were produced owing to the limited requirements of the time.

Labour in sulphuric acid and auxiliary production where corrosive fluids have to be handled is usually paid 25 per cent. higher than elsewhere, and the employers prefer to retain their trained labourers who know how to protect themselves from corrosive fluids. The number of labourers employed in this industry is not very large; nor is size of employment a criterion by which the importance of this industry is to be judged. In fact labour forms a comparatively unimportant element of cost in this and almost all the chemical industries.

B.—In War-time

As has been shown, sulphuric acid enters extensively into munitions production and is also required in the manufacture of essential war supplies. The demand having thus increased and imports being impossible, it was found that the available production was utterly inadequate for the combined Defence and civil requirements, which in 1942 were estimated to be 1,15,000 tons per annum. This quantity includes the requirements of this acid for manufacturing auxiliaries like nitric acid, bichromates, alum and copper sulphate of which there is an Empire shortage during the war. Six new plants have therefore come into being as a result of this, augmenting the production of the acid by about 8,000 tons annually in the year 1943. Simultaneously a statutory control on distribution and prices was instituted in 1942. This control has been successful in keeping the prices steady and in distributing the acid according to the urgency of the needs. Production was also increased, by more fully utilising the existing capacity of the plants, which evidently were idle before the war. Taking the present capacity at 93,000 tons per annum, as against the requirements of 1,15,000 tons, our capacity is short by about 22,000 tons. Attempts were, therefore, made to secure 4 contact plants under Lease/Lend arrangements from U.S.A., with a view to increasing the existing capacity by about 12,000 tons annually. These efforts have not yet succeeded. Notable developments under the stimulus of war are the increased production of nitric acid, copper sulphate and bichromates, all requiring sulphuric acid as basic raw material.

Raw Materials.—The position in regard to raw materials also become important. Supplies of sulphur having ceased to come from Sicily and Japan, the only source available during war-time is U.S.A. But in the meantime, requirements of sulphur went up with the utilisation of the surplus capacity of the existing sulphuric acid plants and the installation of new ones, as well as with the needs of the sugar factories, tea estates, etc. The requirements were thus nearly four times the pre-war. The difficult supply position led to the rediscovery of Koh-i-Sultan sulphur deposits in Baluchistan, which are now worked by the Labour Department and are able to meet a very small portion of our requirements. We have

been luckily able to use Baluchistan sulphur ore as such in chamber plants: non-refined Baluchistan ore is, however, not welcome to the industry, as its use affects the production capacity and involves frequent repairs to the plant due to fine dust choking the acid towers and chambers. The quality of the acid produced is also affected in that some of the impurities of the ore are carried in the acid, making it unsuitable for use in accumulators (Shortage batteries). Besides, the cost of mining and transport and the present crude method of recovery make Baluchistan sulphur four to five times as costly as imported sulphur, whose present price is itself nearly two and a half times its pre-war price. Again, the total quantity of Baluchistan sulphur deposits is hardly enough to supply the normal requirements of the country for more than three years. Our main source of sulphur will, therefore, continue to be imports.

Imports of Chilean nitrate also ceased in war-time and these were replaced by saltpetre (Potassium nitrate) which is available in plenty in this country.

Efficiency of Production.—The new capacity developed during the war is by the chamber process, by utilising the available materials indigenously, *vis.*, lead sheets steel and timber and is of course, not quite so economic as the production from contact plants, which have necessarily, to be imported from U.S.A. The production, however, has kept up a number of other industries consuming the acid. As the cost of acid forms only a negligible part of the total cost of materials in the consumer industries, the uneconomic cost of the acid cannot be regarded as appreciably affecting the cost of production of their finished goods, like textiles, leather goods, etc.

C.—Post-War Adjustment

The quantity of sulphuric acid at present utilised for the production of nitric acid, bichromates and iron sulphate will, it is considered, be reduced to one half or one third after the war. The surplus, so available could be utilised to produce more of alum, magnesium sulphate and superphosphates.

The consumption of sulphuric acid in the post-war period is not likely to go down because the industries consuming it are already established on a fairly sound basis, *e.g.*, textile, iron and steel industries, and oil refineries. As for its consumption in the production of auxiliary chemicals, other raw materials are available in abundance in India, *e.g.*, bauxite for alums, magnesite for magnesium sulphates, bone-meal for superphosphates, chrome ore for bichromates, etc. The question of export need not be considered, as enough is not yet produced for Indian requirements.

Change in the methods of production.—The present method of production, as stated earlier, is by chamber process. It is uneconomical as first, dilute acid is produced, which later has to be concentrated for transport to short distance and for use in certain production where concentrated form is necessary. Concentration requires consumption of fuel and involves a waste in the form of fumes during the process. On the other hand, production from contact type plants yields concentrated acid (100 per cent.) and also oleum (fuming acid), necessary for establishing dyes and drugs industries in future. The new plants and plants to replace the existing worn-out ones should therefore be of the contact type. Their life is greater, as they are simple to operate, and the acid produced therefrom can be transported in steel drums (40, 45 or 90 gallons capacity). Steel drums which are a suitable form of packing for 98-100 acid are corroded by weaker acid, which therefore has to be packed in stoneware jars.

The contact type plants suggested above will have to be imported from U.S.A. The latest patents and designs of plants evolved are available in U.S.A., and their quotations are known to be the cheapest. Except for storage tanks, almost complete plants will have to be imported. Drums for packing and transport should simultaneously be imported, as these drums have to be pressed to make them leak-proof, and machinery for that purpose is not available in India. Welded or soldered drums will not do.

Our present experience is that there is a general shortage of acid in Bengal and Bihar area. So also in the Bombay Province; a busy textile centre like Ahmedabad needs a ten-tons-a-day plant. The Central Provinces have abundant good quality bauxite, where production of alum could be localised by setting up a ten-tons-a-day plant; while one more such plant in the South (Salem District, where magnesite is available) could produce all the magnesium sulphate required for India. A ten-tons-a-day capacity plant in U.P. is necessary to meet the requirements due to increased industrialisation in that Province.

Alternative Raw Material.—In view of the recent decision regarding the increased production of fertilizers, the position in regard to raw materials has to be urgently explored. Our supplies of sulphur are inadequate and the future of sulphur imports is unknown. But we have adequate supply of gypsum, and this ought to help us in the manufacture of ammonium sulphate, seeing that this chemical could be produced by treating gypsum directly with ammonia and carbon dioxide. Gypsum can therefore be considered as an alternative source of sulphur, rather of sulphuric acid; we can use it directly to make ammonium sulphate without producing sulphur or sulphuric acid from it. After all, in any advanced country, at least 60 per cent. of the sulphuric acid production is for the manufacture of fertilizers, and therefore the inadequacy of Indian sulphur supplies need not be considered a serious handicap.

Large deposits of gypsum are found in India, in various places like Kashmir, the Punjab, North-West Frontier Province, Rajputana, Bikaner, Jodhpur, Jaisalmer, United Provinces, Madras, Sind, Cutch and Kathiawar. Assuming that India's need for ammonium sulphate in the immediate post-war years will be about 350,000 tons a year, a supply of half a million tons of gypsum a year will be sufficient. It is estimated by reliable authorities that Indian deposits are more than adequate to meet such needs.

Labour.—Technical personnel in the industry is not likely to be unemployed. Science graduates can be trained in existing plants within two years, to cope with any fresh developments. No foreign training is necessary. Ordinary labour is comparatively a small factor and does not require any serious consideration.

Conclusion.—It will be clear from the foregoing what a large part Sulphuric Acid plays in modern industrialisation. It is vitally needed in most lines of manufactures, whether it be drugs or dyes, fertilizers or insecticides, electrical storage batteries or civil explosives. In fact, nearly all the industries need it. Its supply in adequate quantities and at reasonable prices is thus a pivotal problem and therefore its production in India must be properly planned, if industrialisation is to be accelerated.

ANALYSIS OF THE CONSUMPTION OF SULPHURIC ACID.

A. Production of Auxiliaries by the Sulphuric Acid manufacturers in their own works, in 1943:—35,500 tons.

B. Sales to other industries, in 1943:—38,000 tons.

PRODUCTION AND CONSUMPTION OF SULPHURIC ACID

Particulars	Pre-war	(Figures in tons) 1943	
		Quantity	Percentage
Sulphuric acid (total production)	26,000	73,500	..
Consumption :—			
(a) In auxiliaries :—			
Alums	3,400	4,500	9.1
Hydrochloric acid	270	500	0.7
Nitric acid	400	3,800	5.1
Ammonium Sulphate	11,000	19,000	25.9
Superphosphate	(Not known)	700	0.9
Magnesium Sulphate	1,400	1,800	2.2
Bichromates	Nil	1,700	2.3
Iron Sulphates	220	1,300	1.8
Copper Sulphate	Negligible	600	0.8
Others	..	1,800	2.5
Total ..	16,690	35,500	48.3
(b) In industries :—			
Textiles	..	7,000	9.5
Steel Industry	..	12,500*	17.
Leather tanning	..	1,500	2.04
Paints & Pigments	..	2,000	2.7
Manufacture of other acids	..	2,500	3.4
Vegetable Oil	..	700	0.95
Brass	..	300	0.4
Paper	..	750	1.02
Mineral Oil	..	2,500	3.4
Railways	..	250	0.34
Miscellaneous Chemical manufacture	..	2,500	3.4
Distilleries	..	500	0.7
Battery	..	300	0.4
Medical	..	200	0.27
Glass & Enamel works	..	200	0.27
Other Miscellaneous	..	300	0.4
Government (C. C. P. S.)	..	3,000	4.08
Other Essential Civil Purposes	..	1,000	1.36
Total ..	..	38,000	51.63
GRAND TOTAL ..	..	73,500	100

*Produced and consumed in Tata Iron & Steel Works and Indian Iron & Steel Co.

12. CAUSTIC SODA

The manufacture of caustic soda is known as the alkali industry, involving as by-products bleaching powder and chlorine. Like Sulphuric Acid, the alkali industry is a key industry, essential not only to the normal economic life of a community, but has also a vital bearing on the possibility of national preparedness for defence. As in the case of sulphuric acid, a country's consumption of caustic soda is an index of the extent of its industrialization. This chemical forms a raw material for numerous industries, for example soap, textiles, paper, vegetable ghee, leather, rubber, paint, disinfectants, dyes and colouring matters. Unlike sulphuric acid, which depends on sulphur imports, the major sources of which happen to be enemy countries in this war, the raw material for the manufacture of caustic soda is common salt, an article of every-day use, large quantities of which are, and can be produced in India at a cheap price, being duty-free for industrial purposes. Unlike sulphuric acid, again, the economic production of caustic soda on a large scale depends on the availability

of cheap electric power. Nor does caustic soda enjoy the virtual protection which sulphuric acid has in the shape of heavy freights for imported acid. This probably explains why very little attention was paid to the indigenous production of this important chemical in the pre-war period. The developments of this war, involving as they did heavy curtailment of supplies, have brought to the forefront the country's need for a healthy alkali industry. In view of the fact that the raw material and cheap electric power are already available in the country and will be available in increasing quantity with the development of the large reserves of hydro-electric power estimated at 27,000,000 horse power, of which only 3 per cent. has so far been tapped, there is every reason why we should lay the foundations of a flourishing alkali industry in suitable localities in the country. Caustic soda does not present any case of insuperable problems of packing or transport. It is packed in non-returnable drums made of mild steel (black sheet) and the lid sealed on to it with the help of a bituminous composition. For local consumers, caustic soda can be supplied as liquor of 50 per cent. strength in returnable containers, thus saving the cost due to evaporation and packing.

Though the Indian Chemical Industry was completely deficient in the manufacture of alkalis, little attention was paid to it before the outbreak of hostilities. The years 1936-37 saw the flotation of a few new companies, but they did not work for some years; the war has benefited these new struggling factories by creating a welcome demand for their products and by their being allowed to charge prices nearly double those of the imports. The restricted supplies of some 25,000 tons from abroad were thus supplemented during the third year of the war by indigenous production of some 1,500 tons by the Alkali and Chemical Corporation of India (subsidiary concern of (I.C.I.), and by a further 2,000 tons in the fourth year of the war by the Mejtur Chemical and Industrial Corporation at Mettur Dam in South India. A third firm, Messrs. Tata Chemicals, started in 1939, with its factory situated at Mithapur (Port Okha, in Kathiawar), has just commenced production. Their potential capacity is estimated at 7,500 tons per annum, which it is hoped, will soon be available. There are in addition a few textile and paper mills which have arrangements for producing caustic soda for their own use. Even this has to be supplemented by imports.

Of the industries which use caustic soda on a large scale, soap, textiles and paper deserve special mention. Unrestricted offtake by these consumer industries would be 25,000 tons, 14,000 tons and 6,000 tons of caustic soda per annum respectively, out of a total estimated consumption of 50,000 tons of caustic soda in India. Besides these three which taken together, consume nearly 90 per cent. there are a number of industries which depend on caustic soda to a greater or lesser extent at some stage or other, and which would cease to function without an uninterrupted supply of this chemical, although the volume and value of caustic soda may be an insignificant fraction of the amount and value of the finished product. In this miscellaneous group the refining of oil and the allied vegetable ghee industry is of great national importance. The developments of war cut off the export market for ground-nut oil and made unduly large quantities of this and cotton seed oil available for internal consumption. The utilization of this has to a certain extent been frustrated by the non-availability of caustic soda at present. It would thus appear that with the country's consumption estimated at 50,000 tons of caustic soda per annum, indigenous production, even including the full anticipated production of Tata Chemicals, amounts to just 10,000 tons, i.e., only 20 per cent., leaving a gap of 40,000

tons or 80 per cent. to be filled by imports. The expansion of indigenous production during the war has been held up for want of necessary plants. The Mettur Chemicals and Tata Chemicals had fortunately ordered and obtained their plants from Germany and America respectively before the outbreak of hostilities. During the post-war period, four or five plants, each with a capacity of 8,000 to 10,000 tons per annum, will have to be installed. Their location will obviously be governed by the availability of cheap electric power and in a country of vast distances, by proximity to the market as well. In the Bombay Presidency, the home of textile industry and soap factories, the production of Tata Chemicals, which will only be just sufficient to meet the demands of the Ahmedabad market, will have to be supplemented by another caustic soda plant situated preferably at Bombay. Similarly, a second plant can be located in Bengal to supplement the production of the Rishra Factory; the production of the latter is at present taken by two paper mills, Titagur and Bengal paper mills. A third plant may conveniently be located in the Punjab where rock salt of good quality is available and a fourth in the South, preferably near the sea on the Malabar coast, where Tatas have a soap industry, and large quantities of coconut oil are available for good quality soap manufacture on a cottage industry scale. It is understood that Travancore is about to instal a plant (to be locally-fabricated) at a place forty miles from Trivandrum, but its capacity is understood to be small, *i.e.*, about 300 tons per annum.

ANALYSIS OF CONSUMPTION OF CAUSTIC SODA

Industry	Quantity (Tons)	Percentage of Total	Remarks
Soap and Glycerine	25,000	50	In 1943 established soapmakers were rationed at 50% of their pre-war offtake. No supplies were made to new concerns.
Textiles	14,000	28	In 1943 Defence requirements were fully met and civil textiles rationed at 30%.
Paper	6,000 (plus their own production).	12	The Paper mills production for their own use is estimated at 14,000 tons per annum.
Misc. including oil refining, vegetable ghee.	5,000	10	In 1943 civil requirements were met only at 25%. All new concerns were refused supplies.
Total ..	50,000	100	

13. BLEACHING POWDER AND CHLORINE

Chlorine is a by-product of the electrolytic manufacture of caustic soda. A caustic-soda plant will, therefore, produce for every ton caustic soda .88 ton of chlorine and this chlorine can be converted into roughly 3 times its weight of bleaching powder. With the development of the alkali industry large quantities of chlorine will, therefore, be available not only for use as such, but far in excess of the requirements of the country: as bleaching powder, so that the problem for India will be not whether we can produce enough bleaching powder but rather how we are going to utilise the rest of the chlorine. In this connection it is worthwhile mentioning that in other countries, chlorine is the basis of "Fine Chemical" and Pharmaceutical industries.

Bleaching powder is packed in non-returnable galvanised iron drum and chlorine as liquid chlorine in returnable steel cylinders. (Compressed at 6 atmospheres pressure).

The main industries that depend upon bleaching powder are paper and textile mills, surgical dressing; it is also essential for sanitation and public health purposes. From figures available at present it is estimated that:—

	Tons per annum (approx.)
Paper Mills consume	5,400
Textiles and Surgical Dressings	3,600
Public Health (Mainly sanitation of villages and small municipalities)	1,800
Manufacture of Chloroform and other chemicals	300
Total	11,100
Present indigenous production by Mettur Chemical and Industrial Corpn., and Tata Chemicals	4,200
Deficit	6,900 tons.

This 6,900 tons is now met by imports. Indigenous production can certainly be stepped up to fill the gap. The production capacities of the Mettur Chemicals and Tata Chemicals are 2,500 and 4,500 tons bleaching powder per annum respectively. Messrs. Rohtas Industries have a bleaching powder plant with a production capacity of 1,250 tons. These three come up to a total of 8,250 tons per annum. Mention may also be made of a Government factory at Rishra which was erected at the instance of the Defence Department to produce stabilised bleaching powder. (Capacity 3,000 tons per annum). Most of the indigenous production is the ordinary bleach, which rapidly deteriorates in this tropical weather. The manufacture of the super tropical bleach has therefore to be encouraged. The increase in paper production by the established paper mills as well as by new paper mills should increase the consumption of bleaching powder by paper mills to 6,000 to 7,000 tons per annum. But recently the tendency has been for paper mills to use liquid chlorine instead of bleaching powder. This is actually being done. Messrs. I. C. I. (India) Ltd., are distributing liquid chlorine from Rishra to the paper mills in the Eastern area. The same is the case with large municipalities, who are fast appreciating the use of liquid chlorine in preference to bleaching powder for sterilisation of the water supplies of big cities. Even the textile mills have learnt to use liquid chlorine for bleaching textiles. It has great advantages over bleaching powder especially when the fabric has to be dyed subsequently, as the traces of Calcium salts in the fabric, when bleached with bleaching powder, interfere in the dyeing.

It was observed above, that for every ton of caustic soda produced, 0.88 ton of chlorine would be available. If, therefore, as suggested in the note on caustic soda, plants are installed for the production of 50,000 tons of caustic soda in the country, some 44,000 tons of chlorine will be available of which bleaching powder would consume only 4,000 to 5,000 tons (against the estimated requirements of 12,000 tons of bleaching powder). There will thus be a surplus of chlorine in the neighbourhood of 40,000 tons per annum, available for the "Fine Chemical" industry, as a by-product at a comparatively cheap price. Fruitful lines of activity in this direction will, therefore, appear to be the manufacture of (1) a number of organic solvents, (2) carbon tetrachloride, chloroform, chloral, ethyl chloride, etc., (3)

(through chloracetic acid) any number of "fine chemicals", (4) Hydrochloric acid by burning the surplus chlorine with hydrogen gas, which again is a by-product of the alkali industry. (5) Ferric chloride, zinc chloride, and (6) Barium chloride and chlorate, and potassium chlorate.

14. SODA ASH

The manufacture of Sodium Carbonate, or Soda Ash as it is termed commonly, together with the allied Product caustic soda forms the Alkali industry. Besides being a basic chemical by itself, it is required in times of emergency for conversion into caustic soda by what is known as the causticising process, wherein soda ash is treated with lime available in the country at a very cheap price. Of the two processes for manufacture of soda ash, Leblanc process is now obsolete and AMMONIA-SODA process is the one now generally employed. There is at present one factory in India—Messrs. Dhrangadhra Chemical Works at Dhrangadhra (Kathiawar), producing soda ash by the ammonia soda process. Two other concerns Messrs. I.C.I. (India) Ltd., and Tata Chemicals have also installed necessary plants at Khewra (Punjab) and Mithapur (Kathiawar) respectively and are expected to go into production by the middle of this year. They will also be manufacturing their soda ash by the Ammonia Soda process. The production capacity of Dhrangadhra Chemical works is 18,000 tons per annum and that of Messrs. I. C. I. (India), Ltd.'s plant at Khewra is about 20,000 tons per annum, while that of Tata's at Mithapur is about 36,000 tons per annum. Thus when full production is attained by these three factories, total indigenous production will amount to 74,000 tons per annum against the present estimated consumption of—100,000 tons per annum as shown below:—

ANALYSIS OF CONSUMPTION OF SODA ASH

Name of industry	Quantity of Soda Ash required	Percentage of Total
	Tons	
Glass	20,000	12.5
Paper Mills	10,000	12.5
Textiles	9,000	11.25
Bichromate manufacture	5,000	6.25
Sodium Silicate	3,000	3.75
Ordnance Factories	3,000	3.75
Miscellaneous Chemical Industries	2,000	2.5
Washing and Cleaning	48,000	47.5
Total	100,000	100

The gap between production capacity and consumption is 26,000 tons, but actual production has not come up to anywhere that level, and therefore India is still largely dependant on imports. Even if the three firms mentioned above reach their target figures, new capacity will have to be developed, if India is to supply her total requirements, estimated at about 125,000 tons.

The raw materials for the industry are—

- (1) Common Salt (or Brine).
- (3) Ammonia or its salt (Ammonium Sulphate).
- (2) Lime Stone,

The first two materials are very cheap and easily available in the country. It is understood that the third raw material, namely, ammonia, or one of its salts will also be soon available with the fulfilment of the programme for the Ammonium Sulphate (Fertilisers) industry in this country.

SODIUM BICARBONATE—GENERAL

This is an intermediate product in the manufacture of soda ash and will, therefore, be available from the three factories operating the Ammonia Soda process in the country. The requirements are:—

Medicinal preparations and cooking	4,500 tons per annum
Fire Extinguishers	300 tons per annum
Total Consumption ..	4,800 tons per annum

At present the Dhrangadhra Chemical Works are producing and marketing 1,500 tons. The balance, 3,300 tons can be met from indigenous production, though it is now imported.

15. ALUMS

General.—There are a number of products described as alums. Important amongst these are the following:—

(a) **Alumina Ferric.**—The simplest one and the largest in demand for purification of water supplies and for sizing paper.

(b) **Aluminous Sulphate.**—A purer variety of Alumina Ferric, containing comparatively limited quantities of free acid and oxides of iron, has greater percentage of soluble Aluminium salts than Alumina Ferric, involves better methods of production than those adopted for Alumina Ferric and is consequently slightly higher in cost. It is also used for water purification and for sizing paper. Iron-free quality is also required in dyeing and printing of cotton textiles.

(c) **Potash Alum.**—This is a double salt of Potassium and Aluminium Sulphates, is crystalline in nature and is used in textiles, as mordant in dyeing and printing, as a hardening agent of gelatine films in photography and of soft tissues in medicine and cattle food for camels and buffaloes added to drinking water.

(d) **Chrome Alum.**—Is a double salt of Chromium and Aluminium Sulphates. It is used in chrome tanning, khaki dyeing of textiles and as a hardening agent in photography and film industry; it can be replaced by bichromates in the first two uses and by Potash Alum in the last two.

The first three of the four types described above are produced indigenously by almost all the manufacturers of sulphuric acid. The raw materials are Bauxite (Impure Oxide of Aluminium) and sulphuric acid. Production of the latter is established to a limited extent and a good grade ore of the former is available in C.P. and Central India Agency Tracts. Some finds are also reported in Khera and Ratnagiri District in Bombay, and in Madras Presidency. The Bombay deposits are now being exploited, while the Madras ore is still unused.

The present approximate annual Indian requirements of alums are given below:—

Public Health (for water purification)	Tons
Paper sizing	3,600
Textiles and Miscellaneous	8,400
	1,000
Total ..	13,000

The requirements of public health vary according to the length and intensity of the monsoon. Alumina Ferric or Aluminous Sulphate is used in clarifying town and city water supplies from suspended impurities. Prolonged monsoons and subsequent muddiness of rivers and reservoirs require larger amounts of alums for removing the suspended impurities in water filters. Intense monsoon of a shorter duration requires less quantities. The figures given above of supplies made available are those of the control period and therefore large quantities would be necessary in the future, especially as all the three uses mentioned above are likely to increase after the war.

With the increased production of paper, larger quantities can also be used for sizing to prevent ink spreading on paper. Its limited availability during war has restricted its use in paper industry, producing paper suitable only for typing and for writing with pencil.

The use in textile printing has also been limited to a minimum during war. The requirements for this purpose will also increase in normal times.

One more use deserves special mention. Since 1941, about 300 tons of alum are used annually in the production of foam type fire-extinguisher refills, produced for the first time in India, as these are not available from U.K. or U.S.A. during the present emergency.

Alum in small quantities is also used for impregnating the untipped end of matches to extinguish the flame in time.

Indigenous production.—This is estimated to be 7,000 tons annually. production is kept low, due to the limited availability of sulphuric acid and the difficulties involved in the transport of Bauxite from C.P. and fuel (coal) from Bihar to sulphuric acid factories. About 6,000 tons are imported from U.K. annually to supplement the indigenous production. With increased production of sulphuric acid, production could be stepped up, as fairly large deposits of bauxite are available in India and as no special plant or machinery is required. Only lead-lined wooden tanks are required to produce this commodity. As indicated above, the requirements of alum will greatly increase with the increasing needs of public health and the paper industry. Due to limited availability during war from imports and indigenous production, a statutory control over the distribution of the material had to be imposed. Demand especially during last monsoon could be met only to the extent of 50 per cent. In normal times after war, it is therefore estimated that annually about 20,000 tons of alums will be required.

The chief bottleneck in the indigenous production is limited availability of sulphuric acid. Its production, therefore requires to be stepped up. Production costs compare favourably even in war time with the imported material.

As a precautionary measure against transport difficulty for Bauxite and coal, during an emergency similar to the present one, it is suggested that production should be established somewhere in C.P. or Rewa State (Central India Agency) where large deposits of bauxites and coal are easily available.

16. POTASSIUM CHLORATE

Potassium Chlorate is mostly used in the match industry and to a smaller extent in the manufacture of blasting powders. The pre-war consumption was 1,500 to 1,700 tons and the consumption has not increased as a result of war, owing to the non-availability of other chemicals such

as phosphorus, which are required in the manufacture of matches. Defence Services' requirements of Potassium Chlorate are small, being only 20 tons per annum. Before the war, Potassium Chlorate was imported mainly from Sweden, Germany and Japan and smaller quantities were also imported from France, the U. K. and Finland. With the German occupation of Norway, supplies from Sweden were cut off and there arose a world shortage of Potassium Chlorate. Imports during 1940-41 and 1941-42 were 1,200 and 1,000 tons respectively and those during 1942-43 dropped down to 100 tons.

As a result of the growing difficulties of maintaining the match industry in India, a scheme was drawn up by the Western India Match Co., Bombay (and supported by the Commerce Department) for the setting up of a factory in Bombay for the production of Potassium Chlorate at the rate of 1,500 tons per annum. The factory has now commenced production. In Southern India the Mettur Chemicals and Industrial Corporation have put up a plant capable of producing one ton a day (300 tons per annum but the output is at present restricted to $\frac{1}{2}$ ton a day owing to the difficulty of moving raw material, namely, Potassium Chloride from Northern India. The two plants mentioned above are capable of meeting the total Indian requirements during the post-war period.

Potassium Chloride is a by-product in the refining of potassium Nitrate, which is available in plenty in the Punjab, the U.P. and Bihar, but the price demanded is very high compared with the imported chloride. The chlorate industry in India may not stand foreign competition during post-war period owing to the high cost of production and very high prices demanded for raw material.

17. SODIUM SULPHIDE

General—This chemical was wholly imported into India before war. Its pre-war imports and uses amounted to 1,500 tons annually in 1938-39. In the present emergency, however, its demand suddenly increased, with the result that it was greatly in short supply in the year 1941-42; consequently its price rose to Rs. 30 per cwt., from the pre-war price of Rs. 18 per cwt.

It is used chiefly in tanning industry as a depilatory agent for dehairing hides and in textile industry as a developer of sulphur dyes (mainly Thionyl Khaki, Thionyl Blue for tent Dossutee and Thionyl Black). To a smaller extent it is also required in alkali (soda ash) plants as a rust-preventing agent and in the form of a purer grade in photography for developing sepia tones.

As a result of a general shortage of aniline, alizerine and other vat dyes during war, sulphur colours requiring sodium sulphide as developing agent, were used as substitute dyes. Sulphur dyes had to be used to the greatest extent in the year 1941-42. Since then vat Khaki dyes were available from U.S. A. with the result that demands for sulphur colour decreased to that extent. Thus requirements of sodium sulphide during war have been closely linked with the use of sulphur dyes and war demands of textiles so dyed.

Estimated uses year-wise are given below

	Tannery.	Textiles.	Chemicals industry.
1941-42—3,000 tons annually	600	2,250	150
1942-43—1,800 tons annually	600	1,050	150
1943-44—1,500 tons (estimated as required) ..	600	600	300

Indian Production—Due to general shortage of imports in the year 1941-42 and the first half of 1942-43, stocks and supplies of sodium sulphide had to be controlled informally. Three or four small concerns (at Agra, Bombay and Calcutta) started producing it, each at the rate of approximately one ton a day. These productions in small furnaces have not proved an economic proposition, costs being almost double that of the imported material. The Supply Department has sponsored a project at Jodhpur, producing in all ten tons a day in four units—furnaces—each producing 2.5 tons a day. As the demand in 1944 is estimated to be only half that of 1941-42, it is proposed that for the time being only two units should start working at Jodhpur producing thereby 1,500 tons annually. The production is expected to begin in a month or two.

Sodium Sulphate, the raw material for producing sodium sulphide, is available in plenty at Didwana Salt Range in Jodhpur, and being a by-product of the Salt industry, costs almost nothing to the Jodhpur State. Coal is required to fire the furnaces and as a reducing agent, and bricks for the furnaces have to be transported from Bihar to Rajputana, and these form major items of cost. It can, therefore, be said that the production at Jodhpur will compare favourably in prices both in war and in peace time with the imported material, and it is considered that no protection is required for the industry. As soon as available, a drum-making plant will have to be made available to the Jodhpur production for the proper packing of the sodium sulphide produced there.

A new use for sodium sulphide would be as a causticising agent in the paper industry. Rajputana and the Punjab having no alkali industry of their own, may therefore utilise the surplus, namely, the idle capacity of 1,500 tons annually of sodium sulphide at Jodhpur, by using this material instead of caustic soda used by paper mills at present.

18. AMMONIUM SULPHATE (See Fertilizers).

19. SALTPETRE OR POTASSIUM NITRATE

General—This is an important chemical. The main use is for the manufacture of gun powder. It can also be used as a manure, as it contains two essential requirements of plants growth namely Potassium and Nitrogen, and the only question which will determine its use as a manure will be its cost of production. Saline earth in different parts of India contains nitrates. The nitrate in the soil is the product of bacterial action in the soil in, and around the villages, where a large quantity of nitrogen is derived from the excrement of men and animals, and from vegetable matters.

Pre-War—Upto 1860 India was almost the only source of saltpetre, hence the name "Indian saltpetre" or "Bengal saltpetre for this chemical". The subsequent discovery of deposits of sodium nitrate in Chile (South America) and the development of German deposits, led to the reduction in exports of Indian saltpetre from 35,000 tons in 1860 to 13,000 tons in 1914. World War I saw a revival of the Indian saltpetre industry, its production reaching nearly 30,000 tons in 1917. The industry declined again on the termination of the war.

In War Time—Due to the development of synthetic ammonia and nitric acid in other countries, the present war has not stimulated the Indian saltpetre industry to the same extent as the last war, with the result that the pre-war production of 11,000 tons per year was never exceeded during this war, while during the last war India exported about 26,000 tons per year, most of which went to U. K.

Post-war.—The industry is more or less on a cottage industry basis, not employing any modern apparatus or motive power for the production. It is practically confined to Bihar, U.P. and the Punjab and a few Indian States like Bikaner and Bharatpur. Attention will also have to be paid to the recovery of potassium chloride which is a by-product of the refinement of saltpetre. At present only a few refineries in the Punjab and U. P. do this. The industry has a very wide scope for development, provided it is taken up seriously by any Department, Central or Provincial. There are very large tracts of saline earth suitable for extraction of saltpetre, and their utilisation depends on expansion of indigenous demand or of export demand of saltpetre. As regards indigenous demand, its extensive use as a manure needs to be explored. With a little help, an annual Indian production of at least 50,000 tons could be reached.

20. BICHROMATES

General.—Bichromates are of two forms: Sodium Bichromate and Potassium Bichromate. The former is now produced in India as a result of the impetus given by the present war. Imports fell off at the outbreak of the war and as this commodity was essential for war effort, it became soon evident that India should start producing it, and this was found possible as we have the necessary raw material (namely chrome ore), which was exported as such before the war to England, U. S. A. and other countries. The industry has, therefore, sprung up during war, and a Gazette notification giving the industry protection was issued in the year 1941.

Bichromates are used chiefly for khaki dyeing either by the mineral or the vegetable process; its other major use is in chrome tanning of leather; to a small extent it is used in the production of yellow and green pigments (chrome colours) required by the paint industry. The match industry also consumes approximately 60 tons annually, but it must have potassium Bichromate; Sodium Bichromate being hygroscopic, absorbs moisture and match tips soon become useless. A new use of bichromates has also developed as a result of the present emergency. It consists in the production of chromic acid required in the electroplating industry as well as in anodising aluminium surfaces to make them as hard as steel by electrolytic treatment in chromic acid bath.

As indicated above, there was no pre-war production of bichromates in India. The consumption before the war as indicated by the figures of imports amounted to 900 or 1,000 tons annually. This was mostly used for tanning and to a limited extent for mineral khaki dye by a few mills like Binnys at Madras and Elgin Mills at Cawnpore. With the outbreak of war, however, the demand for khaki dyed cloth suddenly increased, and as vat dyes were not available, most of the textile mills adapted their equipment for dyeing with mineral khaki or vegetable khaki.

At present there are twelve plants producing bichromates in India, producing approximately 250 tons of bichromates per month. We have yet to import about 250 tons per month to supplement the indigenous production capacity, which if worked to the full would produce 400 tons per month, but for lack of transport facilities for coal, sulphuric acid, lime, etc., the production is always interrupted, and full capacity has not been realised.

Raw Materials.—Good quality chrome ore is available in Chhaibassa (Bihar) and in Mysore State. Chrome Ore is also available in Baluchistan from where it is brought to Karachi. Soda ash, lime and sulphuric acid,

the other raw materials required in this production, are also made available to the Bichromate Manufacturers from nearest sources. It is, however, felt that with increased facilities, which would be only available after the war for grinding the chrome ore, and getting better quality of lime, the cost of production would be considerably less than what it is at present, namely, Rs. 85 to Rs. 100 per cwt. as against Rs. 80, the price of the imported material from the U. K. The indigenous production is given a protection by pooling the prices of the imported and indigenously produced material and charging a uniform rate to the consumers. The Government are controlling the production and distribution as also the prices.

The industry is localised at present with a view to meeting area-wise demands. For example Binnys at Madras are producing their own requirements of bichromates, Cawnpore Chemical Works in Cawnpore are supplying the needs of Cawnpore Tanneries; Bombay Bichromate Manufacturers' Association producing 80 to 100 tons per month are supplying the needs of the Bombay textile industry, and small productions in Calcutta and Nagpur are meeting the local demands. Production is, however, in excess of the estimated peace-time demands. The abnormal demand would fall when the war ends, as Khaki cloth and chrome tanned leather requirements would be less then. Estimating the future peace-time requirements of India at 2,000 tons annually as against a pre-war consumption of 1,000 tons, we should still have 2,000 tons spare capacity, and efforts would have to be made to find markets in adjacent countries like Burma, China, Australia, Afghanistan, and Iran. These countries do not make bichromates, and if India could produce bichromates at prices comparable to those of the European and American production, these markets should easily be in our hands. The industry, is considered to be on a sound footing and with the assistance of the Government of India it has got trained technical personnel, conversant with the methods of production followed in England. With chrome ore available in the country, with Soda Ash production developing here, with the already existing capacity of sulphuric acid, and with the allied facilities of cheaper lime and fuel in peace-time, it is considered that bichromates could be produced at much lower prices than at present. The bichromate industry, however, will have to be more efficient in future in that it will have to equip itself with the latest pulverizing machinery for finely grinding the chrome ore and proper mixing of the ingredients before putting them into furnace. This will ensure greater yields than at present.

The monthly production capacity area-wise is as follows:—

Madras and Mysore	..	..	..	..	..	Tons	120
U. P.	..	..	..	..	..		150
Bombay	..	..	..	..	..		110
Calcutta	..	..	..	..	..		20
Nagpur	..	..	..	..	..		5
					Total	..	405

The present annual consumption industry-wise is estimated to be as follows:—

Textiles	..	..	..	..	..	Tons	4,680
Tanning	..	..	..	..	..		600
Production of chrome pigments	..	..	..	..	..		600
Match industries	..	..	..	..	..		60
Production of chromic acid	..	..	..	..	..		50
					Total	..	5,990

It is considered that technically trained personnel is already existing in the industry as an expert, trained in England, has imparted the necessary technical information to the industry. The labour involved in the industry is comparatively an unimportant item and can always be secured from the country; no unemployment is expected, in case the industry exists on its present level. This, however, presupposes finding markets in the adjacent countries to the extent of 2,000 tons. If export demand increases, the production could be stepped up.

CHROMIC ACID

This is made from bichromates and is used for chrome plating. Three or four firms are now producing it in India, their total annual production being 100 tons. This capacity was developed during war and is more than sufficient to meet Defence needs.

B—FINE CHEMICALS

Introduction

Unlike Heavy Chemicals, which are used mainly as raw materials, fine chemicals are directly consumed as finished products like perfumes and drugs. Further, heavy chemicals are produced and consumed in hundreds of thousands tons, and in some cases, millions of tons, whereas the production and consumption of fine chemicals are only of the order of thousands of tons. Nevertheless, the numerous products (as many as 4,000 according to the list of British Manufacture) coming under the category of fine chemicals are of vital importance in peace and in war.

Fine chemical industry in India is still undeveloped, except for the manufacture of tinctures and a few pharmaceutical preparations on a very small scale. Most of them are prepared from imported products. The raw materials of fine chemicals are the products of the distillation of wood and of coal tar. The main products of wood distillation are methyl alcohol (wood spirit), acetic acid, and acetone. Coal tar distillation gives benzene, toluene, aniline, creosote, naphthalene, anthracene etc., which are the starting points for the manufacture of disinfectants, drugs, dyes-stuffs, explosives, etc. The manufacture of plastics is based on phenol, a coal tar product, and formaldehyde, a derivative of methyl alcohol which is a wood distillation product. India, at present, has only a small wood distillation plant attached to the Mysore Iron and Steel Works. There are also one or two small plants for coal tar distillation, but no chemical industry has been built up on them, and when the war came, the Supply Department was forced to arrange for the production on an improvised basis of a few chemicals in short supply, urgently needed for Defence Services.

21. WOOD DISTILLATION PRODUCTS

Acetic Acid

It is a by-product of wood distillation and is used in the rubber industry for the coagulation of latex, in the manufacture of lead acetate and white lead, in dyeing and in the manufacture of medicines. It is also used for the production of cellulose acetate required for the making of artificial silk and cellulose-finish paints. In Canada it is produced cheaply from acetylene gas generated from calcium carbide.

The Indian production of acetic acid before the war was confined to the wood distillation industry in Mysore with a capacity of about 200 tons a year, but the actual annual production came to only 50 to 60 tons,

a major portion of which was exported as Calcium acetate. War has brought a great demand for acetic acid, estimated at 800 tons a year. At the instance of the Supply Department, Messrs. Parry and Company of Madras are arranging to set up at Government's cost, a plant with a capacity of 150 tons a year. The Mysore Government is also trying to set up a plant with a capacity of 600 tons a year, but its production is not likely to begin immediately. After the war, acetic acid can best be produced by the oxidisation of alcohol which is likely to be in surplus then.

Acetone

This is another by-product of wood distillation and its main demand is for the manufacture of explosives. It is also required to the extent of 25 tons a year for use in acetylene gas supply and as solvent for cellulose paints and dopes. Only a small quantity of this demand is met by indigenous production. As the demand went up considerably in wartime, the Cordite Factory at Aruvankadu attempted to produce acetone from calcium acetate, another by-product of wood distillation, but due to the limited supply of calcium acetate which was available only to the extent of about 1,200 tons a year, only about 150 tons of acetone could be produced annually. It was therefore decided to produce acetone from alcohol available from distilleries. A plant was specially imported for the purpose by the Government Cordite Factory which is now producing about 700 tons of acetone a year. Acetone is at present in short supply not only in India but also in the U.K. and the U.S.A. The production of acetone in other countries is connected with that of butyl alcohol and unless the manufacture of butyl alcohol is taken up on a large scale, acetone cannot be produced here at a reasonable price. (See Distilleries).

Formaldehyde

This is produced from methyl alcohol, a by-product of the wood distillation industry. It is required in the making of prescriptions for the preservation of tissues and in the pathological laboratories to the extent of 60 tons annually. Another 50 tons are required for plastic glue used in the plywood industry. It is also used for the production of bakelite powder with phenol, and in the printing and dyeing of textiles.

Considerable quantities of formaldehyde were produced in India during 1929-32, at Kirloskarwadi in Satara District from methyl alcohol obtained from Mysore. But the levy of an excise duty on methyl alcohol by the Bombay Government led to the closing down of the plant with the result that there was no production of formaldehyde in India when the war started. As a result of the investigation by the Board of Scientific and Industrial Research, the Indian Institute of Science, Bangalore, set up a pilot plant. But it did not work efficiently. Later, the Mysore Iron and Steel Works bought the Kirloskarwadi plant and even duplicated it; they are now in a position to produce about 60 tons of formaldehyde a year.

Glycerine

Glycerine is used in medicines and in preparations like antiphlogistine, it is also used in the production of anti-gas varnish. It is a by-product in the manufacture of soap. In India only four soap-manufacturers, all in Bombay, have plants for the recovery of glycerine. The total annual production is about 1,500 tons, one half of which is utilised by the Cordite Factory at Aruvankadu for munitions. India's production is more than sufficient for her needs and for some time she was even exporting some quantities to South Africa, but this has stopped lately.

Oxalic Acid

Oxalic acid is used in dyeing and printing. Before the war there was no indigenous production to meet a demand, about 170 tons a year. War has necessitated its production by a costly process from the bark of Terminalia Arjuna, and about 35 tons a year are thus produced. If the production is to be made economic, this chemical has to be manufactured by digesting saw-dust with alkalis.

22. COAL TAR PRODUCTS

Naphthalene and Creosote

Coal tar is produced as a by-product during carbonization of coal in coke ovens for the production of metallurgical coke. The carbonization of coal is carried out in the Tata Iron and Steel Works and Indian Iron & Steel Works. The by-product, coal tar, is supplied to firms like Bararee Coke Company, Bengal Chemicals and Pharmaceutical Works, Calcutta; and Shalimar Tar Products, Ltd., who distil it for the recovery of naphthalene, creosote and other products. Naphthalene is used for medicinal purposes, for protection of woollen clothing against moth, and to a small extent for the manufacture of other chemicals. Light creosote is used for the manufacture of disinfectants, and heavy creosote, as a wood preservative. The yearly production of light creosote, is about 120,000 gallons; of heavy creosote, 450,000 gallons, and naphthalene, about 1,000 tons. These are the only coal tar products now made in India.

The post-war prospects of this industry are bound up with the development of industries using the various products of coal tar distillation.

23. MISCELLANEOUS CHEMICALS

Photographic Chemicals

These include sodium thiosulphate, sodium sulphite, sodium metabisulphite and hydroquinon. India's requirements before the war were about 500 tons of sodium thiosulphate and 100 tons of sodium sulphite a year; but there was no indigenous production to meet this demand.

With the coming on of war, small plants have been set up all over the country by private firms at the instance of the Supply Department for the production of sodium thiosulphate and sodium sulphite. When all these plants come into full operation, they will be able to supply the total requirements of India, now estimated at 800 tons of sodium thiosulphate and 300 tons of sodium sulphite. As the present scale of operation is small and the equipments are of make-shift type, the cost of production is higher than that of the imported materials. Besides, the main raw materials namely soda ash and sulphur have to be imported.

There is a reasonable chance of these industries surviving the war, with the fall in the price of raw materials and in the production cost.

Chlorosulphonic Acid

This is the basic chemical for the manufacture of a number of products like saccharine, sulphanilamide drugs and chloramine T. The last one is an essential ingredient of anti-gas ointment required for Defence purposes. It is also of great use in the Textile industry. There was no indigenous production of chlorosulphonic acid before the war. After the outbreak of war, at the instance of the Supply Department, Mysore Chemicals and Fertilizers Company put up small plants at Belagula in Mysore for the manufacture of chlorosulphonic acid and chloramine T. from it. The

plants were locally fabricated and the Supply Department deputed a special officer to supervise the production. Improvements were later introduced in methods of production, and it was considered possible to produce 250 tons of chloramine at a reasonable price. But due to the improvement in the war situation, H. M. G. offered to supply an improved type of anti-gas ointment from the U. K. and hence indigenous production was not increased. However, about 2 tons of chlorosulphonic acid a month are still produced by the Firm and mainly supplied to the Halfkine Institute, Bombay, for the preparation of sulphanilamide drugs, and to the Central Board of Revenue for producing codeine.

The post-war prospects of the industry are good for two reasons:—

(1) The main raw material for chlorosulphonic acid is fuming sulphuric acid which can be obtained from the contact sulphuric acid plants. (2) On account of its dangerous and corrosive character, the freight charges on imported chlorosulphonic acid would be very high and would thus give a virtual protection to its indigenous manufacture. The Mysore Chemicals and Fertilizers Ltd., will be able to develop the manufacture of this chemical and allied products, if skilled technical personnel is available.

Zinc Chloride

Appreciable quantities of this chemical are used mainly in the textile industry to prevent the growth of mildew; it is also used for soldering purposes. There was no indigenous production on any big scale, and the requirements of about 3,500 tons were mostly met by imports before the war. Now three or four firms have started the production, chief of them being the Tata Chemicals, Ltd., who will be in a position to produce 1,000 tons per year.

The industry has good prospects after the war, as the raw materials—scrap zinc and hydrochloric acid—are available in this country.

Calcium Chloride

This is usually a by-product of the alkali industry and is used for refrigeration and other minor purposes. There was no indigenous production, and the pre-war requirements, estimated at about 400 tons a year, were met by imports. Now Pioneer Magnesia Works at Khargoda are producing it by a somewhat costly method. Their production capacity is estimated at about 1,000 tons a year.

In view of the fact, that this chemical is a by-product in the alkali industry and there is already a soda ash plant and there will be two more commencing operations soon, there should be no difficulty in meeting the peace-time requirements for this chemical.

Barium Chloride

This chemical is used in water softening, leather tanning and refining of salt solution for the manufacture of caustic soda by electrolysis. The raw materials required for its production are barytes, coal, soda ash and hydrochloric acid. There was no production of this chemical in India before the war. Now it is produced in small quantities by Mettur Chemical and Industrial Corporation, Ltd., and Rohtas Industries. Tata Chemicals are also making arrangements for the production of this chemical. Since India has all the raw materials required, indigenous production could be expanded to meet the entire home demand.

Lead Acetate

This chemical is used in the manufacture of some pigments like chrome yellow and also in water proofing of textiles. There was no indigenous production before the war. Now one firm (D. Waldie and Co.) is producing it. But the cost is prohibitive, as both the raw materials used by the firm, namely, lead and acetic acid are imported products. The post-war prospects of this industry are uncertain.

Air Foam Solution

There was no indigenous production before the war.

Three types of air foam solution required for Defence purposes are now being manufactured.

(a) **Air Foam Solution—Type H.**—The starting materials for this are horns and hoofs from butcheries. This was first developed by the Board of Industrial and Scientific Research and they hold a patent for this. Lately two other firms have developed this and substantial orders have been placed on them for this. The present production can be said to be about twelve to fifteen thousand gallons a month.

(b) **Air Foam Solution—Type B.**—The starting material for this is blood from slaughter houses. Though the method of manufacture is not very difficult and does not involve any complicated machinery, its production has not been developed here so far, due to religious prejudices regarding handling blood. However, efforts are being made to develop its production in all the important centres. The present production is about 500 gallons a month. The whole output is taken up by the Air Force.

(c) **Air Foam Solution—Type S.**—This is a solution of soap, in a mixture of spirit and water, its production does not require any machinery. But because of the scarcity of spirit, its production has not been fully developed.

IV.—INDUSTRIES BASED ON CHEMICALS

24. Fertilisers

Closely linked with the heavy chemical industry, is the manufacture of chemical manures commonly known as artificial fertilisers, chief of them being nitrogen compounds and super-phosphates. The food of plants consists of certain mineral salts like compounds of nitrogen, phosphorus and potassium in forms easily assimilable by plants for their growth. These salts are present in ordinary soils to some extent, but the fertility of virgin soil gets exhausted by cultivation over long periods of time. Indian soils are deficient in nitrogen and phosphates due to the inadequacy of manure and the soil erosion caused by heavy rainfall. Various experiments conducted at Pusa, Madras, Bihar and Burma have shown that the use of phosphates and superphosphates greatly increased the yield of all crops, particularly of paddy. The best results were obtained by using mixed manures containing nitrogen and phosphorus, showing usually an increase of over 100 per cent. in the yield.

But the quantity of fertilizers used in India is negligible, and the yields of Indian crops are very low, being usually a fourth of what are obtained in other countries. Even a small and industrially backward country like Egypt uses 233 lbs. per acre as (against India's 0.61 lbs. per acre) and gets an yield of 3,000 lbs. of rice per acre as against 820 lbs. in India. Korea, Japan and Italy are obtaining still higher yields, four to

five times those of India. This is true also of other food crops like wheat and of money crops like tobacco and groundnuts and fibre crops like cotton. Out of India's total requirements of 55 million tons of food-grains, she depended on imports from Burma to the extent of only 1.4 million tons. The increased requirements for the fighting forces in war time come to another 500,000 tons. Thus the gap between production and consumption of foodgrains, due to war, is only about 2 million, i.e., less than 4 per cent. of the total normal production and if good use had been made of fertilisers, bridging this gap would not have been as difficult as it has proved to be.

The two important fertilisers are superphosphates and Ammonium sulphate. The production of superphosphate in India at present is spasmodic, and dependent on the availability of sulphuric acid. About 2,000 tons of superphosphate produced from bones, horns, etc., may be put down as a rough estimate. Ammonium sulphate is produced and consumed in greater quantities.

AMMONIUM SULPHATE

A.—General and Pre-war

Ammonium sulphate is the most important fertiliser. It can be made by two methods: (1) by neutralising ammonia with sulphuric acid, and (2) by decomposing gypsum with ammonia and carbon-di-oxide. The first method is more costly, since it requires sulphuric acid. The chief raw materials required for the second method are ammonia, gypsum and coke. Ammonia is obtained as a by-product from the distillation of coal, but this supply cannot be increased appreciably. Hence synthetic ammonia is the main source. There are 30 different processes of making synthetic ammonia; of these 10 processes are in general use in countries like U. S. A., Germany, France, Italy and Japan. The most important is the Catalytic (Haber-Bosch) process, by which nitrogen from air is made to combine with hydrogen, obtained by one of the four processes: (1) water gas, (2) coke oven, (3) electrolysis, (4) as by-product of fermentation industries, decomposition of natural gas, etc. The fourth process is not possible in India, and the third one is too costly as it consumes ten times as much electric power as is required for the first process. Hence our main source of hydrogen would be water gas and coke oven gas.

Nitrogen compounds are important for Defence purposes also. Ammonia can be made into nitric acid by the oxygen of the air, and this acid is required for the manufacture of explosives, needed not only for military purposes but also for civil, e.g., in coal and other mines, Railway construction over difficult terrain, etc.

Gypsum and coke, the other raw materials of ammonium sulphate, are available in India. Before the war, about 70,000 tons of gypsum was produced here. Though the Indian gypsum contains impurities of silica, alumina and calcium carbonate, it is found suitable for ammonium sulphate.

The total pre-war consumption of ammonium sulphate in India was only about 100,000 tons a year, more than half of which went to sugarcane, coffee, tea and rubber plantations. The quantity used for food crops like rice and wheat was thus relatively small, and the food crops were totally denied this important fertiliser on the cessation of imports during war. The Indian demand for ammonium sulphate was met largely by imports, though there was a small indigenous production coming to

about 15,000 tons in 1938-39. In the same year, imports came to about 76,000 tons. The following table shows the countries exporting ammonium sulphate to India and their respective shares in 1938-39:—

IMPORT FIGURES OF AMMONIUM SULPHATE

Country	Quantity of imports in (tons) 1938-39.
United Kingdom, including Channel Islands	59,008
U. S. S. R.	7,495
Germany	64
Netherlands	1,140
Belgium	8,834
Japan	100
U. S. A.	107
Total	76,748 tons.

B.—In War-time

The developments of the war, curtailing as they did imports of rice from Burma, coupled with a bad harvest and the destruction of crops by cyclone and floods in Bengal in 1942, brought to the forefront the problem of food. The "Food Grains Policy Committee" as well as the various Food conferences came to the only possible conclusion, namely that at least 350,000 tons of ammonium sulphate a year should be immediately available for increasing the production of food crops in the country. A conference of industrialists and representative of Government Departments was held in September, 1943 under the chairmanship of the Honourable the Supply Member to tackle the production of ammonium sulphate in the country. The Conference confined itself to a short term programme for the production of 350,000 tons of ammonium sulphate in the course of the next two years. Supplies of farmyard manure and night soil of town converted into manure by the hot fermentation process (composting) would be sufficient for the cultivation of vegetables, but not for the production of foodgrains. Of the two alternative sources, *viz.*, imports and indigenous production, the Conference came to the conclusion that while shipping space will not be available for such a large quantity of ammonium sulphate, it will be available for importing the necessary plants from U. S. A. to set up production in India.

To produce 350,000 tons of ammonium sulphate, 500,000 tons of gypsum and 150,000 tons of coke would be required. Production of gypsum has fallen from the pre-war figure of 70,000 tons a year to 60,000 tons. But in the production of coke, the five existing coke oven plants in Bihar have a surplus capacity of 500,000 tons a year. There is no need therefore to fear any shortage of coke, the present coke oven capacity is more than enough for our immediate purpose. There is only one plant producing synthetic ammonia, *viz.*, the Mysore Chemicals and Fertilisers, with a capacity of 1,400 tons of ammonia equivalent to about 5,600 tons of ammonium sulphate. The Ordnance factories are now taking 1,000 tons of ammonia from this source; hence only the remaining 400 tons are available for conversion into about 1,600 tons of ammonium sulphate. The coke oven plants of Tata Iron and Steel Company, Indian Iron and Steel Company, Bararee Coke Works, Government Coke Ovens and Bhowra Coke ovens have a total capacity of 26,000 tons of ammonium sulphate. As one coke oven is not working, the present production is about 20,000 tons of which only 10,000 tons are now available for use as

fertilisers. The total existing capacity is therefore only about 32,000 tons and even if the Mysore plant is duplicated it will be just 37,000 tons of ammonium sulphate per annum, i.e., about one-tenth of our immediate requirements.

The following table shows the production and consumption figures of ammonium sulphate in India before and during the war:—

INDIAN CONSUMPTION OF AMMONIUM SULPHATE

		(Figures in tons).	
		1938-39	1942-43
Imports	..	76,748	1,361
Indigenous production	..	14,860	25,060
Total Supply		91,608	26,421
Less exports		1,313	..
Total consumption		90,295	26,241
Market price per ton Rs.		108	260

Better Utilization of Coal for increasing supplies of Ammonium Sulphate.—As the establishment of a synthetic nitrogen fixation industry will take time owing to delay in importing machinery, the suggestions made by a competent authority (Dr. H. K. Sen) for increasing the supply of ammonium sulphate within a short period of 6 months may now be considered. Firstly it is estimated that about 50,000 tons of ammonium sulphate are recoverable from 4 million tons of coal used by the coking industry in one year as against the 26,000 tons they are now producing. Secondly the present stock-burning for soft coke manufacture consumes about 1.5 million tons of coal. If this quantity of coal were retorted under special conditions, it is estimated that 10,000 tons of ammonium sulphate could be recovered in addition to about 18 million gallons of useful oils and 4.5 million gallons of petrol. Thirdly the Railways consume 7 million tons of good coal, which when coked could yield 87,500 tons of ammonium sulphate, provided a rationally processed coke were used for locomotive purposes; or if soft coke could be used by the Railways, 46,000 tons of ammonium sulphate could be recovered. Fourthly the large electric power stations which generate about 1,000 million units annually using coal for steam generation, can, by changing over to Mond gas firing of their boilers and erecting a by-product (ammonia) recovery plant, produce annually about 40,000 tons of ammonium sulphate at the rate of 80 lbs. of ammonium sulphate per ton of coal gasified. The equipment necessary for the recovery of the by-product, ammonia, is simple and easy to manufacture indigenously. By these four methods, it is estimated that an additional quantity of 120,000 tons could be produced within the next six months.

It is also suggested that in the present conditions of India, an easier method of fixing nitrogen through calcium cyanamide could be made use of, even though it is far more expensive than the catalytic process. It requires 5 times the quantity of coal for the same amount of fixed nitrogen. Excepting for the power-producing machinery and an air-liquefaction system all parts for the manufacture of calcium cyanamide can be easily fabricated in this country.

C. Post-war

Increasing the production of ammonium sulphate depends mainly on the availability of new plant which has to be imported from abroad. Many industrialists in India are willing to take up its production if the necessary plants are available. The location of these plants would depend to a large extent on nearness to the supply of gypsum. According to the

reports of the Geological Survey of India, there are large deposits of gypsum in several parts of the country, and ammonium sulphate plants could hence be set up in many places. The localisation of the industry would also depend on the supply of coke, on transport conveniences, supply of power and proximity to markets. Certain industrialists, it is understood, are already making investigations about the most suitable places to set up the ammonium sulphate plants. Expert advice will be required to build up the industry on sound lines. At the initial stage, experts will have to be brought from abroad until Indian chemical engineers, trained in the U. S. A. or the U. K., are able to operate the plants.

Plans will also have to be made for the adequate production of superphosphates and potash salts in order to supply a balanced food for the plants. If India is to develop her agricultural potentialities fully to maintain her increasing population, she would require several million tons each of ammonium sulphate and superphosphate. For her 20,000,000 acres of irrigated land under rice alone, at about 1 cwt. per acre of each of these fertilizers, she would need 1,000,000 tons of each fertiliser. It would therefore be desirable to fix a programme to aim at a target figure of 1,000,000 tons each of ammonium sulphate and superphosphate in the immediate post-war period. This can in no way be considered ambitious, for even a small country like Egypt uses 500,000 tons of fertilisers per annum.

25. DRUGS, MEDICINES AND DRESSINGS

A.—Before the War

Before the war, the production of Drugs in India was confined to the manufacture of easily made galenicals and proprietary medicines except a few articles of a complicated nature. The Natural Drugs produced in India before the war included items like Morphine (before the war hardly 200 to 300 pounds per annum), Natural Codeine (about 20 to 30 pounds a year before the war). Strychnine, Ephedrine (hardly a few pounds per annum), etc.

The production of synthetic drugs in pre-war India was even more meagre. The chief difficulty in this line has been the lack of basic chemicals and intermediates of coal-tar origin. Another handicap for the synthetic drug industry in India was the lack of necessary equipment.

B.—In War-Time

To encourage indigenous manufacture of medical stores, a Medical Stores Supply Committee was set up (in 1940), which undertook a survey of the Indian manufacturing capacity, investigated and recommended substitutes as far as possible for drugs on the essential list, and encouraged economy in the use of articles only obtainable from abroad. By these means India's output of medical stores, which amounted to about 25 per cent. of her requirements on the outbreak of war, has now (1943) risen to 66 per cent. The number of indigenous items of medical supplies rose from 1745 in 1941 to 2351 in 1942 (July). The value of medical stores supplied up to June, 1941, was 20 times the normal supply to military hospitals. India has been able to accept responsibility for supplying all kinds of medical stores to all the forces in the Far East, and the Middle East.

The following figures show the increase in the value of medical stores purchased in India, compared to the value of imported drugs and medicines:—

Year	Value of medical stores purchased in India		Value of imported drugs and medicines	
	Rs.		Rs.	
1938-39	15,80,212	2,20,53,230		
1939-40	24,51,798	2,61,21,895		
1940-41	1,04,44,287	2,18,69,046		
1941-42	2,79,21,940	2,77,76,061		
1942-43	3,48,48,587	1,47,03,762		

The Medical Stores Supply Committee, which was formed in May 1940 has several sub-committees to investigate special subjects. A sub-committee was formed on the production of Dried Blood Plasma in India. The investigation was set up at two centres—Lahore and Calcutta. Later two plants to manufacture Dried Blood Plasma on the Desivac system were ordered from America. One of these arrived in January 1943, and has been put into operation; the second is expected shortly.

An American mission (Grady Mission) came to India to assist the Government of India in obtaining certain plants required to speed up and extend the manufacture of drugs in India. Certain plants are on order, (1942) especially with regard to the manufacture of Phenol and certain coal-tar derivatives. The Medical Stores Committee set up by the D.G., I.M.S. in conjunction with various experts, have now found Indian substitutes for a variety of B.P. Drugs which are not procurable in India. Difficulties are still being felt for items like Benzoin and Balsam Tolu, etc., and systematic investigations are being made at the Research Laboratories to find suitable substitutes for these.

Drugs of Natural Origin

With the fall of Java and consequent shortage of quinine, the production of synthetic anti-malarials such as Atebrine (Mepacrine) and Plasmoquin (Pamaquin) has become important. Two or three firms in India were in a position to prepare them but were handicapped by the lack of coal-tar intermediates, about 14 in number. Another difficulty was that the Patent rights for these drugs were vested in an enemy firm. The Controller of Enemy Patents leased these out to certain English and American firms for production and distribution within their respective spheres.

Increasing the production of quinine from the present figure of 90,000 lbs. per annum has also been considered. By the older process, the plant takes 5 years to mature for the insolation of quinine from its bark. The new Russian experiment of extracting quinine from one year-old Cinchona trees is engaging the attention of the Government. India's present production capacity of quinine falls short of her requirements by at least 60 per cent. Before the war, Indian quinine could not compete with Java's product, although the difference in production costs was not considerable. Considering the wide prevalence of malaria in India and its injurious effects on industrial efficiency, the question of safe-guarding India's quinine supply at reasonable prices is a most urgent one.

With an improvised equipment and a simplified process, over 1,000 pounds of morphine was produced in 1941, in about 5 weeks (pre-war production figure 200 to 300 lbs. per year). By "synthetic" means about 300 pounds of Natural Codeine was made in 1941 (pre-war figure—20 to 30 pounds a year). The synthetic process for its preparation has now been

standardised in all details. The manufacture of Alkaloids in India is only in its infancy. Strychnine is the only alkaloid produced on a large scale and the only one in which India has a monopoly. India is perhaps the largest manufacturer of strychnine salts—about 15,000 lbs. per annum, and it leaves a wide margin for export. Ephedrine is also produced in large quantities (pre-war production hardly a few pounds per annum). Now 2 or 3 firms and the Medical Stores Depot Factory at Chheharta produce large quantities; the process of extraction has been simplified so that it can now be prepared with solvents which are easily available in India. Other Natural Drugs now produced here on a considerable scale include Atropine, Kurchi Alkaloids, Santonin, Caffeine-Citras, and Emetine Hydrochloride from pecacuanha grown in Bengal.

Caffeine Citrate (Caffeinae Citras) was previously imported from Germany and Holland, where it was extracted from coffee, and as the coffee without caffeine was saleable at a higher price, it was possible to sell caffeine as a by-product at a price below cost. Thus these countries were able to capture wide markets and keep them for long. At the commencement of war, the Empire countries found themselves in great difficulty in regard to supplies of caffeine. An Indian firm, (Bengal Chemical and Pharmaceutical Works) came forward and extracted the same from tea-dust, which was formerly exported for fear that it might be put to illicit use. They got alluring offers from London for the supply of this drug, but with commendable patriotism, agreed to supply the drug at the rate of Rs. 10 per lb. (while in London the price was for 46 shillings per pound).

Santonine used to be the monopoly of Russia. In 1930, a firm in Kashmir began its production, but its prices were very high. Now Bengal Chemical Company is making it. It is doubtful if the industry will be able to meet Russian competition after the war. Since the outbreak of the war, Belladonna, Ephedra, Henbain, Rhubarb, Valerian, Nux Vomica, etc., are exported from India on a large scale. Ethylchlorid is also produced on a large scale, though its production was at first handicapped by lack of glass containers. Now a Calcutta firm supplies the containers.

Vitamins and Hormones

The Production of Adrenalin Hydrochlorid, Extract Pituitarij Liquidum and Thyroid siccum, Vitamin 'A' from spinach, Vitamin 'C' in concentrated Amla and Calciferol is in progress, though the cost of production of some of these like Calciferol is rather high.

The production of shark liver oil to the extent of 10 to 15 thousand gallons annually also satisfy the demand for vitamins. Shark liver oil is richer in vitamin 'A' than cod liver oil whose supply has been curtailed by the war. By diluting shark liver oil with a good quality groundnut oil, a satisfactory substitute for cod liver oil is found, with rich prospects of export trade. This is the revival of an old industry of Cannanore and Cochin which had died out subsequently.

Oleum Hydnocarpus, a vegetable oil produced by the cottage industry in Malabar, is now used on a large scale to manufacture Ethyl Esthers of Hydnocarpus oil in the Medical Stores Department factory at Madras. This oil is the chief therapeutic agent in the treatment of leprosy.

The manufacture of essential oils like sandalwood oil and small quantities of peppermint oil and dill oil is also in progress. Indian production of Eucalyptus oil has also increased, although its content of cineole is low.

Purified Basic Chemicals

Since the outbreak of the war, steps have been taken to produce Bromine. A factory already exists for the manufacture of Liquid Chlorine, but the production is not sufficient. A certain amount of organic anti-moni-als and arsenicals are also produced here. One of the most important basic chemicals which is in world shortage is Potassium Salts. Steps have been taken to produce Potassium Salts from Bengal Saltpetre and molasses. Due to lack of sufficient supply of sulphur, the Indian production of sulphuric acid is low, and this has adversely affected the production of such substances as Alum ferric, Magnessii sulphas, Nitric acid, Hydrochloric acid, etc.

Sulpha Drugs

During recent years, Sulpha Drugs have acquired a great deal of importance. There are certain drugs belonging to this class, which are not protected by patents-for example, Sulphanilamide, prontosil, etc., whilst drugs like Sulphathiazole, Sulphaguadine, etc., are all patented by May and Baker and allied firms. A certain amount of unpatented drugs has been produced to overcome the immediate difficulties in India. But here again, the chief bottleneck is the lack of two important ingredients; one is Chlorosulphonic Acid which is now manufactured to a limited extent at Mysore. The other is Aniline. Aniline is one of the most important starting materials not only for the drug industry but also for the dye stuffs industry.. India's production of aniline was nil at the beginning of the war. To meet the emergent needs, the Drugs and Dressings Directorate stimulated its production by very small manufacturers, who neither had the equipment nor the capital to make its production very economical; the bigger concerns were not interested in this line. The patented sulpha drugs usually have a very short vogue, and therefore it stands to reason that if the two important basic materials such as aniline and chlorosulphonic Acid could be produced in India, India will have a chance to get in this field of production newer drugs that may be ultimately evolved.

Other items.—India's manufacturing capacity for tinctures and liquid extracts of various kinds is about 250,000 gallons per year (Dec. 1942).

Other items recently manufactured on a large scale in India are Potassii Permagnas from Indian manganese ore, Creosote from Indian wood distillation products, Nikethamide, a derivative of Nicotinic acid, chloroform, Chloral Hydras, Bleaching powder, Acidum Aceticum Glasciale, Acidum Carbolicum. Acidum Cresylic for the manufacture of Saponified Cresol, Lysol, Oleum Terebinthinae, Acidum Trichloroaceticum, Ammonium Chloride B.P., Ampoules Gum Saline, Amylis Nitris B.P., Carbonaei Tetrachloridum, Anti-mosquito cream, Injectio Bismuthi, Liquor Formaldehyde, Oleum Anisi, Sodii Tauroglycocholatę, etc.

Liquid Glucose was imported not only for medicinal uses, but also for use in the manufacture of textiles. It is now produced in some quantities in India from Indian starch.

Attempts are made to develop Coal-tar distillation industry, and Coal-tar products like Benzene, Carbohc Acid, Saponified Creosol, etc., are produced in India. Coal-tar Benzene is a valuable solvent used in the Drug industry up to 1940. There was an excise duty on Benzene used for commercial purposes. The duty on benzene used for pharmaceutical products has now

been removed. The interests of the Indian Drug industry require a supply of Benzene free of excise in the post-war period also.

Since the outbreak of the war, about 300 items which were formerly imported are supplied by Indian firms under the direction and guidance of the officers of the D.G., I.M.S. The production of anaesthetic ether has reached the figure of 15,000 lbs. a month.

The percentage of items of the priced vocabulary of medical stores manufactured in India now is about 70 per cent.

Dressings

The development of surgical dressings industry in India has been very rapid. The production capacity of India of absorbent cotton wool (19/42) was about 120,000 pounds per month. Lint is made by several firms; its monthly output is about 25,000 pounds. During 1941-42, the two surgical dressings factories in South India made 4 1/2 million shell dressings, 1 1/2 million first field dressings, 600,000 Triangular bandages, 12 million bandages 2 to 4 inches in width and a million compressed dressings for field medical equipment. Later a new Government Medical Store Department factory was established in North India with a monthly production capacity of 700,000 shell dressings and 120,000 first field dressings. In 1940, in one indent, about 6,700 miles length of textiles was converted into bandages. The percentage of items of dressings indigenously manufactured in August 1942 was 88 per cent.

Ligatures.—India is producing about 10,000 tubes of sterilized catgut per month at the Central Research Institute, Kasauli (1942).

Centres of Production

The Medical Stores Department is one of the biggest manufacturers of drugs and dressings in India. The 5 Medical Stores Depots at Madras, Bombay, Calcutta, Karachi and Lahore had in the beginning, that is 80 years back, laboratories attached to them. These laboratories were first started in Lahore and Calcutta. Later they were shifted to Madras and Bombay. In 1880, it was considered cheaper to centralise manufacture in the laboratories attached to the Depots at ports. Hence the equipment at Lahore was transferred to Bombay. The equipment at the Calcutta laboratory was transferred to Madras as labour and land was cheaper in Madras at that time.

During the last war (1914-18) the name Laboratory was altered to Factory and these factories were taken over by trained chemists, and production in the Madras and Bombay factories increased enormously from that period. Extensive use was made of locally grown vegetable products and minerals and raw materials obtained in India. Now these depots are manufacturing 350 items from indigenous raw materials. In addition, a Shell Dressing Factory has been attached to the Madras Depot. The Madras Depot has also a branch for the repair and electroplating of instruments.

The lion's share of the war demand of drugs and chemicals are being met by private firms centred in Calcutta and Bombay. There are also some imported firms in Baroda, Amritsar, Cawnpore, Aligarh, Lucknow, Lahore, Bangalore, Mysore and Madras.

One of the chief difficulties which the Indian manufacturers have left is the high transport charges prevailing in India. As an illustration, the freight from Orissa to London of Nux Vomica Seeds was approximately

the same as the Calcutta manufacturers have to pay to bring them from Orissa. The question of freight should be one of the principal items for the post-war planning to decide.

C—Post-War

Owing to the rush of war-demand some mushroom concerns have perhaps sprung up, and they have got on under the abnormal conditions of the time. But many of the producing units are fairly well established and may survive the War. Conditions have lately been becoming favourable for the development of a drugs industry. For one thing, alcohol, which enters so prominently into the production of drugs is now produced in large quantities in this country at reasonable prices. Several basic chemicals have also been developed under the stress of war. Some of the drugs like quinine are: national health and may stand in need of encouragement. What such drugs are and what steps should be taken, are matters which call for further enquiry.

2b. DISTILLERIES (ALCOHOL)

A—Pre-war

Alcohol has a wide range of uses and therefore its production is a basic industry. Large quantities of it are used for potable and medicinal purposes and for making paint varnishes, etc., enters largely into tinctures, anaesthetics, etc. It is the source of denatured spirit, which is used for cooking and many other purposes. Power alcohol is used as motor fuel and is very important in the transport industry. The industrial importance of alcohol lies also in the fact that the following articles are made from spirit as required for war purposes:—Acetone (used essentially for explosives), fuel for tommy cookers, Air foam solution, jack, fluid and dope thinners. Ethylestetic is used in the manufacture of plastic wood for aircraft propeller repair and for gran scaler for air-craft.

The bases for manufacturing alcohol are molasses and Mowha flowers. Alcohol is produced as the fermentation result of the sugar content of the raw material. By treatment it can be converted into such articles as (i) Country Spirit (ii) Rectified spirit (iii) India made foreign liquor (iv) Power Alcohol (v) Denatured spirit. There are also by-products like Carbon Dioxide and fusel oil. It is also possible to recover potashes from the spent wash, but this has not been done on a commercial scale in India.

Country spirits are used largely for home consumption rectified spirits are used for medicinal purposes and in ammunition factories for manufacturing fulminates. Foreign liquor like whisky, brandy, rum and gin are made from alcohol. The use of power alcohol as motor fuel has been coming into great prominence for supplementing the supply of petrol. In the States of Hyderabad and Mysore this is widely used in the State transport system. Powder alcohol is also used for dope manufacture and for medicinal purposes.

Centres of production.—Of the raw materials mentioned, molasses is obtained in large quantities as a by-product of sugar manufacture. Hence the importance of the alcohol industry in U. P. which is the largest centre of sugar industry. Before the war the use of molasses for this purpose was not extensive. Bihar has large supplies of molasses and has coal (which is essential for the industry), but it has been lagging behind in alcohol production. The Mowha flower is mostly found in U. P. and C. P. the alcohol manufactured is almost entirely from Mowha flower, In Bombay and Madras also alcohol is made from molasses available in the province. Bengal supplements its supply from Bihar and U. P.

B.—In War-time

War has given a great stimulus to the production of alcohol. Large demands for alcohol came from the Cordite Factory (Aruvankadu), High Explosive Factory (Kirkee) Ordnance Services and Railways, and Central Provision Office. In 1943, the demands for all these Defence purposes amounted to 1,003,000 gallons. Another million gallon was used for war effort in an indirect way, *i.e.*, for use in medicines (D. G., I. M. S.), fuel for Tommy cookers, Jack Fluid, Air Forces De-Icing Spirit, Aeroplane Dopes, etc. Of this 300,000 to 500,000 gallons went to drugs and medicines. The of production are given below for various Provinces and States.

At the same time the potable and medicinal use of alcohol also increased largely, especially as there has been a great expansion of the fighting forces.

In order to meet this increased demand, one distillery has been started in U.P. and eight more are under construction. Bombay Province and Kapurthala State have each a new factory being constructed. All these have received assistance from the Provincial (or State) Government and the Supply Department.

Actual statistics of production are not available. Approximate figures of production are given below for various Provinces and States.

		L. P. Galls, per month (thousands).	
<i>Provinces —</i>			
Punjab	1,34	} —717,500 L.P. Gals.
U. P.	.. .. .	1,95
Bihar	.. .. .	89
Bengal	.. .. .	1,79
C. P.	.. .. .	Not known
Bombay	.. .. .	65
Sind	.. .. .	13
Madras	.. .. .	42
<i>INDIAN STATES.</i>			
Hyderabad	60	} 66,000 L. P. Gals.
Mysore	.. .. .	60
Bhopal	.. .. .	4
Baroda	.. .. .	22
Total per month	8,83,500	
For the year 1942-43	10,602,000 L. P. Gallons (approximately).	

Thus out of about 10.6 million L.P. gallons of alcohol distilled in 1942-43, only about one-third went into Defence requirements and the remaining two-thirds were used for civilian consumption. There is scope for further production, if need be. Some portion of the molasses produced in U.P. and Bihar is used up in sweetening tobacco, and the rest is either destroyed or thrown into the fields as manure. The possibility of using this for alcohol manufacture depends on the pace of industrial development in India and the availability of export markets after the war. Much will also depend on the production cost factor.

C.—Post-war Adjustment.

The entire quantity of Alcohol now being used for war purposes may be required after the war. The demand of the ammunition factories will no doubt fall, but a large extension of the use of power alcohol and of denatured spirit is likely. The production of the distilleries in the course of construction will also be required, if recent industrial development is maintained.

It is not unlikely that a small fraction of the production may be exported as India-made foreign-liquor and denatured spirit.

Possible new lines of production.—Manufacture of (i) either on a commercial scale (for medical purposes) and (ii) higher alcohol (for amyl, butyl, isopropyl, etc.). The manufacture of synthetic essences (fruit essences) is also possible.

All the technical personnel now employed may be retained if production is planned as stated above.

27. PAINTS AND VARNISHES

A.—General and Pre-war

General.—Paints, varnishes, enamels, distempers, and dry colours are of great importance in modern industry. They are used in the interior as well as the exterior of public buildings and dwelling houses. High grade enamels for exterior use are employed on tram-ways, houses, railway carriages and ships. It is a severe test for an enamel to be subject to exposure under the exacting Indian conditions of high-temperature and excessive humidity. Varnishes are used for a variety of purposes. Anti-corrosive compositions for iron and steel work—the means by which the battle against rust is waged—are used for various purposes from the garden fence to the mammoth bridge, on railway wagons, ships, dock-yards, etc. Anti-fouling compositions are used on ship bottoms. Special formulations are needed for corrugated roofs, workshops and factory machinery. The specific requirements of different industries are to be met by special preparations, for example (1) lead free paints, varnishes and enamels, for the food industries, (2) stoving blacks and enamels, for the cycle industry and other steel products (3) enamels, for the furniture trade and petrol cans, (4) stoving lacquers, for tin-ware, collapsible tubes, etc., (5) insulating varnishes, for the electrical industries. Thus this industry is a necessary adjunct of civilized life to-day.

A paint or enamel is produced by grinding together a pigment or mixture of pigments with oil or specially compounded varnishes adding driers, and thinners suitably. A varnish is obtained by cooking a drying oil like linseed with a varnish making gum, adding proper driers and thinners.

India is rich in most of the required materials. Among paint vehicles, the most important are linseed and tung oils. Excellent linseed oil is produced in the country in large quantities. The question of making India independent of China for her requirements of tung oil has been taken on hand, and experimental growing of tung trees in the different tea estates of Assam and other places has been undertaken. Among pigments, white lead, red lead, zinc oxide and leaded zinc oxide are being produced by Indian factories, but from imported metals. Other important items imported are: copal gums, synthetic resins, chlorinated rubber, Lithopone, titanium dioxide, lamp black, ultramarine blue and pigment dyestuffs. The following raw materials are indigenous:—Barytes, bauxite, gypsum, china clay, asbestine, kieselguhr, magnesite, red and yellow ochres, micaceous oxide of iron, synthetic oxides of iron, ilmenite, rutile, lead chromes, zinc chrome, Prussian blue, Brunswick green, chromium oxide green, resin, estergum, cashew shell oil, shellac, litherge, manganese dioxide pitch, beeswax, shellac wax, paraffin wax, hide glue, casein, dextrin, turpentine, Methyl alcohol, denatured spirit, fusel oil, acetone, turpentine substitute and coal-tar distillates.

When India's natural resources are fully surveyed, perhaps the entire range of materials required for the manufacture of paints, enamels and varnishes may be found here.

Production and its Localisation

The first paint factory in India was started in 1902. Since then, production has increased greatly. The estimated production for 1937 was 20,000 tons and for 1938, 24,740 tons. This, however, met only about 60 per cent. of India's requirements.

Production is largely localised in Calcutta and Bombay (see the list of factories in the appendix). This is partly because these are the largest consuming areas. In Bengal the abundant local supply of linseed is an added advantage. South India has similarly an advantage in that barytes which is one of the main ingredients in a variety of cheap paints is an exclusive monopoly of the area (Cuddappah and Kurnool). But only one factory is located in Madras, and one in Hyderabad.

In most of the factories the machinery is operated by electric drive. In the varnish section the pots are heated by coke or gas. The amount of capital invested in the industry is estimated at Rs. 150 lakhs.

B.—In War-time

Changes in lines of production.—In war-time the industry was called upon to supply paints and finishes for the following purposes also:—

1. Camouflage Paint.
2. Anti-gas Varnish and Gas Resisting Paint.
3. Air Craft Dope.

Camouflage paints are special preparations, drying without any gloss or sheen, and conforming to the prescribed shades. They are used on buildings, vehicles and on a variety of other objects. Anti-gas varnish, formulated from wholly indigenous materials, like shellac, glycerine and linseed oil, is employed for proofing cloth, to produce gas resistant fabric. The production of varnish in 1943 was 400,000 gallons. The paint has similar properties and is used where resistance to gas is desired. Nitro-cellulose dopes for application to aeroplaned fabric are now manufactured, using waste film, shellac or castor oil. Up to August 1942, dope production in India was not considered a practical proposition, except by importing 80 to 90 per cent. of the ingredients. The formula was shrouded in mystery. A new formula was later developed (as above) in which 85 per cent. of the material is indigenous and even the 15 per cent. which is now imported will probably be available from indigenous sources. The manufacture does not require any elaborate machinery. We are now able to manufacture about 100,000 gallons annually and this can easily be increased. With light modification, the formula can be adapted for car finishes, high quality furniture lacquer and manufacture of artificial leather.

As 'luxury finishes' are completely displayed in war-time, imports of raw materials from overseas were very much restricted. However, for meeting the needs of war production, the following commodities were imported in 1942:—

Lithophone	..	..	..	1,000 tons from U. S. A.
Gum	..	..	..	350 tons from Belgian Congo.
Colours	..	..	..	150 tons from U. K.
Turpentine substitutes	..	..	..	2 million gallons from the Persian Gulf.

Efforts were also made to develop raw materials at home. In particular, mention should be made of (1) the introduction of Bauxite as a pigment material (2) the extension of the use of earth pigments with a view to conserve chemically prepared whites and lead chromes, (3) the exploration of possibilities of Easter gum and shellac, the only indigenous resins in replacement of imported copals and synthetic resins and (4) the production of dehydrated castor oil which is a partial substitute for tung oil.

Total Production.—The estimated production in 1942 for paints and enamels was 30,000 tons, and only 25,000 tons was consumed in India in 1942. This does not, however, represent 5,000 tons of normal export business, as commercial exports were on a very small scale. This 5,000 tons actually was almost wholly on behalf of the C. P. O.

The different purposes for which the paints were used are given below:—

(a) War orders	..	..	..	..	..	80%
(b) Civil consumption	..	..	..	..	..	19%
(c) Civil export	..	..	..	..	..	1%

C.—Post-war Adjustment

Much of the output now purchased by the Supply Department will be suitable for the civilian market after the war. The material now used for camouflage paints, etc., can be diverted for the production of industrial finishes, protective and decorative. This will not involve any change in plant or any additional outlay of capital. Should additional demand arise in regard to house paints, ship paints, etc., the industry will be able to supply them as most of the raw materials are available in India.

For high quality enamels and paints, synthetic resins are essential and could be made from raw materials available in India. The most widely used synthetic resins are phenol, formaldehyde and glyptal. The raw materials are crysol, a coal-tar product, and formaldehyde which is already produced from methyl alcohol at Bhadravati Iron Works, Mysore. Glyptal is made from glycerine which is available in large quantity from soap works and phthalic anhydride, which can be made from naphthalene, also a coal-tar product.

Insulating varnishes which are required for all electrical appliances can be made mostly from synthetic resins.

These and other possible developments depend on the pace of industrial progress in India after the War.

28. OXYGEN ACETYLENE.

A.—Pre-War

This industry is an important subsidiary to modern engineering and to the iron and steel industry. It is essential for gas-welding of both ferrous and non-ferrous metals and for the accurate flame-cutting of steel and iron.

The first factory in India was started about 20 years ago. Oxygen and dissolved acetylene are manufactured in two different factories and are brought together through the medium of a Blow Pipe. Before the outbreak of war there were factories making both oxygen and dissolved acetylene at Calcutta, Lahore and Bombay. There were oxygen factories only at Jamshedpur and Kargali. Oxygen compressing Stations were located at Cochin, Bangalore, Bombay and Cawnpore. Since 1940 about 9 factories have been added (2 in Bangalore, 1 in Jamshedpur, 2 in Cawnpore, 2 in Barrpur). A factory is now being started at Dibrugarh for breathing oxygen for high flying, essential for military requirements. As the container is 10 or 12 times the weight of the commodity itself, transport is a

very expensive item and therefore it is best to locate the industry near industrial areas in order to avoid heavy transport charges. Therefore the units may be scattered, provided the optimum size is kept up.

In 1935, the principal producing units in India were purchased and brought under amalgamation by the India Oxygen and Acetylene Co., Ltd., which thus has acquired a virtual monopoly in the Oxygen and Acetylene distribution set-up. This amalgamation establishment set out to study the immediate industrial situation and the industrial potentialities of India with a view to creating an entity on which confident reliance would be placed by employed personnel, consumers of goods and shareholders alike. The nine new factories above mentioned were started by this Company on the basis of a ten-year plan calculated to serve Indian Industrial development. Erection of more factories is contemplated. The amalgamation concern is now supplying the whole of the internal market. The location of the existing units and the nature of their production can be seen from the following table:—

OXYGEN AND D. ACETYLENE PRODUCING UNITS, IN 1935 AND 1944

		1935	1944
Calcutta	.. ..	2 Oxygen factories 1 D/A factory	1 Large oxygen factory. 1 large D/A factory. 1 O2 compressing station.
Jamshedpur	.. ..	1 Oxygen factory	1 enlarged O2 factory.
Lahore	.. ..	1 Oxygen factory	1 D/A factory. 1 Oxygen factory.
Bombay	.. ..	1 Oxygen factory 1 O2 compressing station	1 D/A factory. 1 enlarged O2 factory. 1 O2 compressing station.
Colombo (Ceylon)	.. ..	1 D/A factory 1 Oxygen factory	1 enlarged D/A factory. 1 Oxygen factory.
Kargali	.. ..	1 Liquid O2 factory	1 D/A factory. 1 Liquid O2 factory.
Burnpur	.. ..	.. ..	1 compressing station. 1 Oxygen factory.
Cawnpore	.. ..	.. ..	1 D/A factory. 1 Oxygen factory.
Cochin	.. ..	.. ..	1 O2 compressing station. 1 D/A factory.
Bangalore	.. ..	.. ..	1 compressing station. 1 O2 compressing station.
Madras	.. ..	.. ..	1 D/A factory. 1 O2 factory (being built). 1 O2 compressing stn. (being built). 1 O2 factory (being built). 1 Godown.
Dibrugarh	.. ..	.. ..	1 D/A factory (being built). 1 O2 factory (being built).
Rangoon (Burma)	.. ..	.. ..	1 O2 factory. 1 D/A factory (destroyed).
Karachi	.. ..	Godown	Godown.

B.—In War-time

The demand for Oxygen and Dissolved Acetylene greatly increased as a result of war and partly owing to the company's propaganda, demonstration and service. The increase in production can be seen from the following table:—

		1938	1943
		Ra.	Ra.
Oxygen	.. ..	14,21,850	29,08,413
D/A	.. ..	4,54,216	19,91,808

The increase in production was effected mostly within the capacity of the existing plant, but some additions to plant have also been made.

The Supply Department orders came to 25 per cent. of the Oxygen and 30 per cent. of the D. A., produced by the Company. The balance went into civil consumption.

The amalgamated concern is believed to be efficiently conducted and it is considered that it can hold its own in any free market.

C.—Post-war

The whole of the present production can be used for civilian consumption after the war, but the actual post-war consumption will depend upon the pace of industrial development in the country.

Of the materials used in the industry Calcium carbide and acetone were previously obtained from Europe, Canada and South Africa. Acetone is now obtained from the Government factory at Aruvankadu, and the manufacture of Calcium carbide is projected by an Indian concern, in the Bengal Coalfield Area.

Labour brought in this industry is small. Technical personnel has been trained by the Company and will be retained after the war.

29. GLASS

General.—“Three basic commodities, steel, cement and glass, are playing a preponderant part in the development of the material civilization of our times. Of these, glass penetrates probably deeper into the private life of individuals, and exerts a more direct influence on their personal comforts, as symbol of light, transparency and hygiene. From a statistical point of view, the consumption of glass is an unmistakable measure of the prosperity of a country. The U. S. A. tops the list both of producers and consumers of glass, absolutely and per head of population.” In India, this development has only begun, but holds out good prospects.

A.—Before the War

The Indian glass making industry had made considerable progress before the war. According to a very conservative estimate the annual production of glass and glassware before the war was of the value of Rs. 2 crores. The total imports in 1938-39 came to 1.25 crores. Thus Indian production met about 60 per cent. of the total estimated demand. In 1914, Indian production met only the fourth of the estimated demand of the type. In fact, internal production increased by 250 per cent. between the two wars.

Not only was the Indian glass industry able to meet a large part of the home requirements but also enjoyed a large export trade which amounted to Rs. 1.29 lakhs in 1937-38. The exports went chiefly to Burma, Ceylon, Iran, etc.

As in the case of other industries the Indian production consists of (1) a cottage industry and (2) a modern factory industry. Bangle making has long been a cottage industry in India, and before the war it was the only adequately developed branch of the indigenous glass industry. Over 80 per cent. of bangles absorbed by the Indian market was Indian made. It flourished specially in places like Ferozabad, in U.P., Belgaum in Bombay, and the State of Mysore where there is hereditary skill in this line of work. In recent times artisans purchased glass blocks or cakes from the glass factories and made out of them bangles in small furnaces in their homes.

This cottage industry had to face a serious competition from the factories and from Japanese imports and as a result, it now confines itself to the production of decorative bangles on a small scale. Factory-made bangles are Firozabad's sole monopoly in all India and have pushed out Japanese bangles to which they are superior. The ancillary operations like 'joining' and 'decorative operations' on the factory-made bangles are being done by small shops existing in hundreds around the bangle factories.

The following classes of goods were made by the factories:—(a) glass cakes (b) beads, bottles, phials, tableware, etc. Some of the factories which were well-equipped produced also (c) sheet glass. Some also started making surgical and laboratory requirements in glass. Only two factories were equipped for making surgical laboratory requirements.

The improvements made in glass production were largely due to the work of the Technical Research Institutes for Glass at Benares. In this way new types of glass products such as glass beads, false pearls, ornamental glass plates, tubes, pipes, etc., were introduced. The reduction of duty on imported soda ash also helped the expansion of production.

In 1938-39 there were a hundred and one factories distributed among the Provinces as follows:—

Province	No. of factories
U. P.	38
Bengal	28
Bombay	19
Punjab	3
Madras	1
Delhi	1
Indian States	11
	<hr/> 101 <hr/>

The three chief raw materials used are soda ash, sand and lime (or limestones) which formed 33, 67, and 10 per cent. of the raw material cost. Therefore the reduction of duty on Soda ash was of great help.

The glass industry is localised in the United Provinces, because of its Central situation, availability of glass working labour, suitable sands, Government's support and above all the existence of an old-established tradition for glass making, which is the result of the pioneering work of a few individuals and their perseverance and tenacity.

B.—In War-time

War has made great demands on the glass industry. Owing to the stoppage of imports and also the increase of war demand, the need arose for the manufacture in India of sheet glass, hollow-ware, bottles, etc.

Sheet Glass.—This is used extensively in house building especially in urban areas. Before the war India was dependent on foreign supplies of sheet glass has expanded from 1,000 tons to 5,500 tons of window glass per year. After 1939, the production of sheet glass has expanded from 1,000 tons to 5,500 tons of window glass per year. The same firm has started another sheet glass factory at Kandra, equipped with a plant of higher production capacity imported from the U. S. A. under assistance from the Supply Department. It is believed that the Indian Sheet glass factories will be able to withstand post-war competition. The Allahabad Glass Works, Naini, manufacture a type of rolled

window glass of the 'cathedral' type, similar to sheet glass, with figures embossed on them.

Hollow-ware.—A remarkable expansion has taken place in this branch of the glass industry, producing articles in great demand like tumblers, lamps, globes for chimneys, hurricane chimneys, etc. Within two years nearly all factories have made a fundamental improvement by the change-over from old-fashioned pot furnaces to tank furnaces or to modern pot furnaces. In this way one of the greatest handicaps has been removed; the melting of glass has been simplified and made cheaper. The factories with expanded production have been able to cope with the growing war demand for tumblers, chimneys, etc., imports being closed practically. There is no shortage of these articles in India now. The working processes applied by the factories producing hollow-ware are mostly manual, with the exception of glass presses. A new development is the use of jar-making machines and finishing machine, introduced lately on Government initiative.

Bottles.—Bottle manufacture in India was much less developed than other branches of the glass industry and its products had great difficulty in competing with imported bottles. Larger bottling trades like distilleries and pharmaceutical concerns could not use them owing to their irregular capacity, poor finish, unsuitability for mechanical closing and insufficient chemical and mechanical resistance. The creation of a few adequately equipped bottle factories of medium size appeared imperative even before the outbreak of the war. And when the war broke out, European imports stopped and imports from Japan were reduced. This has given a great impetus to the indigenous manufacture of bottles and phials, and many factories have been established. In 1941 a bottle factory at Ramnagar, Benares State, was started by the Vibhuti Glass Works Ltd. It has a tank furnace and semi-automatic machines which have an advantage over manual production, because they assure better uniformity by bottles and a precision of closure, unattainable by hand. Screw neck bottles will also be made on this plant. Continuous annealing Lehr, of a novel type have been installed in this factory so as to assure a high degree of mechanical strength in the goods produced. Another new factory to manufacture better glass table-ware and bottles has been started in Ghaziabad by Capital Glass Works Ltd.

Allahabad Glass Works, Naini, and Naini Glass Works, Naini, are the two old established factories making bottles. The Bombay Glass Works, Dadar is also equipped with semi-automatic machines for bottle-ware. In Bijnor, about 35 small factories on a cottage industry scale turn out small bottles by hand process in their little home-made furnaces and sell them at a surprisingly low price. The two new factories at Ghaziabad and Benares are at the two opposite ends of the Province, so as to enable exports towards east and west. The Benares factory was estimated to produce in 1942 about 3,500 tons of bottles and Ghaziabad about 2,000 tons, while the smaller factories at Sasni, Harangau, and Shikohabad are expected to produce 1,000 tons each of hand-made bottles per year. Thus U.P. alone is expected to produce about 10,000 tons of bottles.

Fancy Goods.—In several towns, around Hathras (U.P.), fancy goods such as glass buttons, pendants, animal figures and a very crude variety of beads known as cattle-beads are made on cottage scale by about 50 workshops, engaging several hundred persons. The manufacture of glass pearls and beads has been practically unknown in India until a year ago, while the yearly imports amounted to nearly 15 lakhs of rupees, its retail value being

at least Rs. 25 lakhs: Production of such beads by independent cottage artisans have now been started with Government assistance and arrangements have been made (1940) for a training centre in Benares. Some control by the Government may be helpful over this new trade so as to avoid waste and over-production.

Scientific Goods.—Scientific glass apparatus, neutral, and semi-neutral, and other scientific classes are now being produced in India as a result of the war demand. Further details about their production are given under the heading 'Surgical Instruments'.

Thermos Flask.—Efforts are being made for the production of thermos flask, which is coming more and more into everyday use and has an unlimited scope for expansion. Experiments for its making are in progress in several factories, notably in Ganga Glass Works, Balawali. Messrs. Victory Ltd., Bombay have been able to produce Thermos Flask refills, which hitherto were being imported.

Glass Bulbs for Electric lamps.—Another new development in glass industry during war is the production of glass bulbs for electric lamps. As imports were cut down, the electric lamp manufacturing industry found difficulty in obtaining the glass shells for the electric bulbs, and at the instance of the Supply Department, indigenous production of glass shells were developed in U. P. by Ganga Works, Balawali, and Kaycee Glass Works, Shikohabad. The former have been making all types of hollow-ware before the war, well known for the quality of its glass. In 1940, the firm erected a modern pot furnace with technical and financial assistance from Government and the new furnace enables them to produce hard glass for laboratory vessels, tubings and rods. Production of glass shells for electric bulbs was developed out of this, and the development is entirely due to war effort. The Kaycee Glass Works, Shikohabad, were built at the instance of Government to meet the demands of glass shells for electric bulbs; the firm had already an electric lamp manufacturing concern, called Radio Lamps Ltd., and they also acquired Hindustan Lamp Works at Shikohabad. The U.P. Government gave them the necessary technical assistance in erecting and developing the production of these glass bulbs. This was done at the instance of the Supply Department.

Bengal Lamp Works have their own glass furnace for making glass shells. They have developed their production of these glass shells during the war period to meet their own demands. A smaller firm in Calcutta, Shri Gobind Deo Glass Works, have also started producing glass shells for the Lux Lamps Ltd. It may be mentioned here that the Kaycee Glass Works have started producing tubings and rodings for electric bulbs.

Bangles.—This is an old established industry. It is concentrated in Ferozabad in U. P. where a population of about 40,000 is engaged in glass trade, carried on in cottage shops and the factories. With the stoppage of the imports of Japanese and Czechoslovakian bangles on the outbreak of the war, Indian bangle industry has made great progress in production accompanied by technical progress in several directions, especially in producing block glasses and bangle coils or spirals in factories.

Technical developments.—The furnace is of primary importance in the glass manufacture, and development on modern lines has been affected during the war period so as to obtain higher temperatures, with economic use of coal, and to obtain correct temperature for fusion and melting of quality glass. In order to stimulate a quick adoption of modern glass melting

Furnaces, designs of furnaces were acquired from abroad and their actual construction was subsidised. Independently locally made designs are being distributed and encouraged in various ways. Within the last 2 years, nearly all the factories have made a fundamental improvement by the change-over from old-fashioned pot furnaces to tank furnaces or to modern pot furnaces. This has simplified melting of glass and made it cheaper. Technical advice in these respects has found particularly favourable ground with manufacturers since the outbreak of the war, and has resulted in the construction of numerous furnaces mainly of the tank type. The furnace developments have been mostly in the direction of recuperative and regenerative furnaces. The most original is the 12 pot recuperative gas fire furnace completed in 1943 by Ganga Glass Works, Balawali. This furnace is the first of its kind in India and was built entirely from Indian materials and has proved successful in every respect. Improvements in moulds and in technique have also been obtained through the technical advice of Government Glass Technologist, U.P. as well as by obtaining glass experts from foreign refugees. These technical developments have resulted in production of superior glass in large scale and at a cheaper rate due to higher temperatures now obtained in the improved furnaces.

Glass house pots were formerly to be imported from Japan, but a domestic production has now started and pots superior to Japanese pots are nowadays manufactured in India, especially at Balawali, as a result of work done on Indian Refractories. Further researches and developments are in progress.

C.—After the War

The new developments are all such as could be continued after the war, for civilian needs. However, certain adjustments will be required in the conversion from war to peace production. The glass industry like the iron industry is divided into many sub-branches. Each of them has a more or less defined minimum working unit below which it cannot be run on a satisfactory basis, whether from the economic or from the technical point of view. For example, in bangle industry small scale is the optimum scale, while in the hollow-ware industry only mass and medium scale production is profitable, because a certain minimum equipment in this line is necessary.

As shown above there are good prospects before the industry and there may be need for the creation of new units of production, for branches hitherto either not existing or not sufficiently represented in this country. But careful discrimination as to the choice of the manufacture to be launched, the size of the working unit and its financial basis is necessary. A copying of already existing, apparently lucrative business may only result in destructive internal competition, since the capacity of the market for certain articles is limited. Possibilities for new manufactures must be investigated and explored.

30. SOAP INDUSTRY

Soap forms the single greatest contribution of Science to personal hygiene. The importance of soap in the category of consumer goods will thus be obvious; Soap is an article of every-day use and its consumption will increase with the increase in the *per capita* income of a nation. Soap is more widely used in urban areas than in rural and with the increasing industrialization of the country larger and still larger quantities of soap will be required.

The raw materials for soap are (1) oils and fats, (2) caustic soda. For every maund of oil, one-sixth to one-seventh of its weight of caustic soda is required. Besides, when oil is refined or turned into vegetable ghee, the oil-waste is usually turned into soap. Thus soap factories serve as valuable adjuncts to the oil refining and vegetable ghee industry.

There was a soap industry of moderate size in India before the war. The increased demand of the Fighting Services and the curtailment of imports of foreign soap, estimated at a value of rupees forty to fifty lakhs per annum should have stimulated indigenous production. But the difficulties of obtaining supplies of caustic soda from abroad, and the need to make greater and greater quantity of this chemical available to the textile industry on war work, led to a situation of denying this chemical even to established soap makers, not to speak of increased supplies to them or to new soap factories. The soap production was, therefore, considerably curtailed in 1942, and in 1943 caustic soda was rationed to established soap-makers at 50 per cent. of their pre-war off-take and the improvement in the supply position of caustic soda has only made it just possible to ration it at 75 per cent. this year, except to Messrs. Lever Brothers, Tatas, Godrej and Swastik who get 100 per cent. of it, as they are engaged in production of glycerine required for Defence purposes. At the same time the demand for soap for supply services absorbed a good proportion of the production. In 1942, the soap supplied to the Fighting Forces, came to 11,000 tons with the result that the quantity of soap available for civilian consumption was considerably reduced. In view of the fact that the industry was carried on by several thousand people on a cottage industry scale, scattered throughout the country, no data for total production is available. It is, however, possible to estimate the pre-war and the present production of soap from the quantity of caustic soda consumed. The pre-war production can be put down at nearly 150,000 tons of soap and the present production* at 1,30,000 tons soap per annum. The soap production and capacity area-wise is given below:—

SOAP PRODUCTION (APPROXIMATE)

	1938-39 (tons)	1944 (estimated)
Bombay	55,000	50,000
Madras	32,000	27,000
Karachi	29,000	22,000
Calcutta	41,000	31,000
	<u>157,000</u>	<u>130,000</u>

(*The production in 1943 was about 90,000 tons).

There are two processes of making soap: (1) cold, (2) boiling. Most of the indigenous soap manufacturers are using the cold process and make inferior type of soap, used as washing soap, dhobies' soap, etc. The manufacturers with the necessary plant and equipment use the boiling process and make both washing and toilet soaps of fairly good quality, which compare favourably with the imported soaps. Some of these manufacturers have even got plants for recovery of the glycerine which is a by-product in the manufacture of soap.

The soap industry has a great future and thrive in the post-war period even without protection. There are no special problems relating to availability of raw materials or labour. In the matter of technical knowledge, some of the Indian Universities have already instituted technological courses of which soap manufacture figures as an important subject in their curriculum. The Universities would, therefore, be turning out persons suitable for employment as chemists in soap factories.

31. CEMENT

A.—General and Pre-War

The cement industry was well-established in India before the war. Its production was controlled by five companies:—The Associated Cement Companies Limited, Bombay, Dalmia Cement Limited, Dalmianagar, the Assam-Bengal Cement Company Limited, Calcutta, the Son Valley Portland Cement Company, Limited, Calcutta, and the Andhra Cement Company, Limited, Bezwada. Cement factories lay scattered throughout the country, but most of them were in Central and Northern India. Factories are generally located near supplies of limestone, the chief raw material for cement. Proximity to markets is also an important consideration. Clay, gypsum and coal are the other main raw materials used. About 1.6 tons of limestone are required to make 1 ton of cement, which contains 4 per cent. gypsum and 38 per cent. coal.

What is known as the wet process is employed in the manufacture of cement. Limestone is crushed and admixed with clay in suitable proportions and up to 33 per cent. of water. This stage is known as slurry. The slurry is fed to the Rotary Kiln and is clinkered by firing the Kiln with pulverised coal. The Clinker is then ground in a ball mill at which stage Gypsum is added giving the final product of Portland Cement. The machinery can be classified as of the heavy type, and approximately 100 units of electrical power is required to manufacture one ton of cement.

Most of the labour force is required for quarry work and is unskilled. In the factories, both skilled and unskilled labour is employed, besides the highly paid administrative, medical and engineering staff. Labourers are paid daily wages and part of the work is done on the piece rate basis. Labour conditions in the cement factories are considered good with the provision of free houses and other amenities and conveniences. Before the war the whole output of Indian cement was sold in India excepting for a small export to Ceylon.

B.—In War-Time

With the increase in demand for cement for Military purposes, production increased in all the factories in India. This has necessitated an increased allocation of coal to maintain all the factories on full production. The increase in output can be seen from the following table.

FIGURES OF CEMENT PRODUCTION

Year	Total despatches from the factories (in tons)
1939	15,32,748
1943	20,58,321

The increase of production by a third was secured by the expansion of plant and equipment and not by working more shifts, as in the cement industry the factories were already working on a 24-hour basis for an average of 350 days in the year. The additional production is of the Portland Cement quality, according to the British standard specification. The capital required has been obtained from the reserve and depreciation funds of the companies. The cement requirements for Military purposes and for non-military purposes of Provincial Governments are drawn through the Supply Department. In the early years of the war, large quantities were exported to Malaya, Java, etc., mostly for defence purposes.

To ensure adequate supply of cement for urgent Government purposes, both military (chiefly for aerodrome construction) and civil, the Government of India in August 1942 instituted a control of the cement industry directing that 90 per cent. of the output should be supplied under the Engineer-in-Chief's quota and the balance 10 per cent. under the Honorary Cement Adviser's civilian quota, which included the requirements of Provincial Government, Central P. W. D. Railways, Port Trusts and the various quasi-Government bodies. Subsequently as aerodrome construction made progress, the civilian quota was increased gradually. At present about 80 per cent. of the output goes for war purposes and the balance 20 per cent. is available for essential civil needs. To effect a better and more economic distribution of the civilian quota, Honorary Regional Cement Advisers have been appointed with their offices in Lahore, New Delhi, Cawnpore, Calcutta and Bombay respectively. About 1 per cent. of the civilian quota is exported to Iraq and Iran for the use of the oil companies. The present production in India, *i.e.*, about 200,000 tons a month, is, however, insufficient to meet in full urgent military and civil demands, and the policy of starving civilian needs any further is not favoured. Hence arrangements are being made to import limited supplies from abroad, to the extent of about 50,000 tons a month.

C.—Post-War

The whole production of Indian cement industry in India now going to war orders will be required for civilian consumption, especially if some of the major projects like Hydro-electric and Irrigation schemes involving the use of large quantities of cement are carried out. A more rapid industrialisation of the country would also lead to a large increase in the use of cement. After the war, there may also be a demand for exports to Burma, Malaya, the Dutch East Indies, Mauritius and Ceylon, because the cement plants in Burma and Dutch East Indies have been denied to the enemy and will probably take some time to be rehabilitated. As the normal peace-time expansion of the cement industry was only 100,000 tons per annum, new cement factories will have to come, and extensions to existing ones will have to take place in order to keep ahead of the demand. Most of the new plant required could be fabricated in India in the workshops of the cement factories and only articles like power plants, boilers, reduction gears, electric motors, switch gears, etc., will have to be imported from U. S. A. or U. K. The demand for new types of cement such as low heat cement, water repellent cement, plaster cement, etc., may be increasing after the war. Their production, however, does not call for any new machinery. It is likely that changes in regard to localisation may take place depending on the discovery of new deposits of raw materials and marketing conditions; the cement industry, however, cannot be pursued on small scale methods in rural areas. The raw materials serving the existing factories are adequate for a life, ranging between 20 and 100 years. The Mining and Geological Department of the Associated Cement Companies is carrying on investigations for new deposits of raw materials suitable for the manufacture of portland cement. Certain valuable deposits have already been discovered. The technical personnel now employed may be retained in the industry, and as the industry expands, more technicians may be required and they can be trained in the existing cement factories. There may not be any unemployment for ordinary labour also, since the industry is not likely to contract after the war.

32. ASBESTOS CEMENT PRODUCTS

Asbestos cement goods are the only asbestos products whose manufacture has been developed in India. The main raw material is asbestos, a term which embraces a number of minerals all of which can be split into fibres capable of being spun or felted together. When bent, the fibre should be unaffected beyond being split up into finer fibres; inferior materials either break or go to powder. Fibres of medium length mixed with portland cement, usually in the proportions of 15 per cent. asbestos and 85 per cent. cement, are made into tiles and flat and corrugated sheets for building purposes. During recent years, the increasing manufacture of asbestos cement pipes has led to a greatly increased consumption of these fibres, generally designated by the broad term of 'shingle' fibres.

Before the war, Asbestos Cement Ltd., Bombay, had a factory at Kaymore, C. P., with a manufacturing capacity of about 1,200 tons a month of asbestos cement products. They were using indigenous cement and the location of the factory at Kaymore was mainly due to its proximity to cement supply. Later they erected two more factories, one at Mulund, Bombay, and the other at Calcutta, to have the advantage of nearness to the two chief markets. In all the factories Indian cement was being used, and asbestos fibre was obtained from Africa, Cyprus and Canada. Asbestos is found in many parts of India like Cuddapah in Madras, Seraikala State in Bihar and Hassan and Bangalore Districts in Mysore. But none of these sources have been developed to any great extent, nor do they supply fibres of good quality.

Asbestos cement goods manufactured in India may be graded under two main headings:—

- (a) Roofing sheets and Flat building sheets with fitments.
- (b) Building pipes, accessories and gutters of various diameters and sizes, comprising of some 1075 items.

The process of manufacture requires special imported machinery worked by electricity. A small percentage of labourers are skilled, the rest being semi-skilled and unskilled. Labourers are daily paid on piece-work basis.

India was also importing asbestos cement goods in considerable quantities. In 1937-38, the import figures came to 3,234 tons. The major share of the imports came from the U. K., Belgium and Jugoslavia.

With the failure of the imports from the Continent, on the outbreak of the war, the Indian factories have had to increase their production to meet the enhanced war demand, and the Calcutta factory which was remaining closed, started production. The total productive capacity of the three factories of the Asbestos Cement Ltd., is 6,500 tons monthly, of which 75 per cent. is taken up by the various Departments of Government including Defence Services.

The whole of the present output would be suitable for the civilian market after the war. India may develop her own sources of raw asbestos fibres, especially the Hassan deposits in Mysore, but imports may not cease altogether. Since the other important raw material, cement, is locally produced, there seems to be no danger of the industry being adversely affected by foreign competition. The experience of the pre-war period is that as the Indian industry developed, imports gradually declined, from 5,779 tons in 1934-35 to 2,969 in 1936-37 and 3,234 in 1937-38.

V—TIMBER INDUSTRIES

33. SAW MILLING

A.—Before the War

Saw milling in India before the war was in a rather undeveloped state. There was very little modern machinery at work in any province except perhaps on the Malabar coast and in a few scattered districts of Bengal and Assam. The modern hand mill had been introduced in these districts, but only with comparatively small machines.

A large portion, at least 80 per cent. of all timber extracted from India is hand-sawn and there are very few forest areas suitable for the installations of large saw mills because of the difficulty of extracting sufficient quantities of timber to a central mill site.

B.—In War-time

When Burma timber, particularly teak, was being imported into India, there was little necessity to utilise inferior Indian timbers. The reason for this was that Burma teak (probably the finest timber in the world for general purposes) was very easily obtainable at reasonable prices. With the entry of Japan into the war and the loss of Burmese supplies, it became necessary to utilise Indian timbers to the fullest possible extent. The Timber Directorate immediately started to erect mills and to encourage saw milling in the districts. Unfortunately there was no modern machinery obtainable and light hand-saw machines made in the Punjab had to be utilised. The Central Government built three mills, one at Poona, one at Khandwa (C.P.) and one at Seoni (C.P.), mainly to produce timber for the manufacture of ammunition boxes as these were then much in demand. Contracts for sawn timber were placed with a large number of private saw milling contractors who in turn set up small saw mills in districts to implement the existing sawing capacity. Most of these mills were equipped with the small Punjab band-saw which is not a very efficient machine, it being too-lightly built to deal with hard-wood sawing or anything in the nature of fast cutting. In May 1942 and later, enquiries were made in U. S. A. to find out if anything was available in the way of more modern machinery. The Timber Directorate has imported a large second-hand band-saw mill from America, and this is being erected at Jhelum in the Punjab. Three large portable hand mills were also imported and two of these are being erected at the Timber Depot, Bombay and one at the Timber Depot at Calcutta. Although the mill at Jhelum is second-hand, it is much larger and more up-to-date than any mill at present in existence in the country. The portable band mills are also better and bigger than the majority of the existing plants.

The fear is expressed that it may be difficult to develop the saw milling industry to any great extent in India, (a) because there are very few places where extraction of timber to a central point is an economic proposition, and (b) because Indian timbers generally are rather inferior in quality and are not very suitable for export. Generally speaking coniferous soft woods grown in this country are heavily knotted, and hard woods are not in sufficient quantities to be commercially exploited. Malabar teak does compete and has always competed in the market, but the volume of such timber is not great.

Actual saw milling in India is very much behind modern practice. The care and attention required to be devoted to large band-saws is generally not understood and this results in great wastage and inferior sawing. Bad

sawing is always a great disadvantage because apart from the loss in cutting, it is reflected in the selling prices of timber.

In order to develop the saw milling industry it will be necessary to ensure that there is a staff of trained saw filers available for the work. Attempts are being made by the Timber Directorate to train saw filers, but they are very much handicapped by the absence of sufficient trained personnel for teaching. The Timber Directorate have brought a man from America to operate the large mill at Jhelum and have also a saw filer from Burma on their staff as Assistant Director. There are not many others properly trained in the country.

It would be well worth while to set up a training school at some central point in India where saw filers can be given a 12 to 18 months course to fit them for the work. An attempt is being made in this respect by the Timber Directorate at Poona, but owing to the lack of trained teaching staff, not much progress has been made. It is intended to start schools at Bombay and Jhelum if the personnel can be found to run them.

C.—After the War

There is bound to be a large demand for sawn timber in the years immediately after the cessation of war, and, therefore, there is no need for anxiety in regard to the future of the saw milling industry. The industry as such can be kept alive by the introduction of more modern methods of extraction and milling.

34. PLYWOOD

A.—Before the War

Only plywood of commercial quality was being made in India before the war. This comprised of large-size sheets used for panelling, furniture, house building and general utility purposes, and panels for tea chests. The demand for the second group was comparatively large. But India had few factories in operation with the result that large quantities of plywood for tea chests were imported every year mainly from the U.K. This plywood was actually produced in the countries bordering the Baltic Sea: Finland, Poland, Russia, Estonia and Latvia. Japan was then dumping considerable quantities of the cheap type of plywood into India. In 1938-39 plywood and Lamin boards worth Rs. 12 lakhs and tea chests worth Rs. 90 lakhs were imported.

There were only 3 plywood factories in India before the war. Two of these were in Assam; the Assam Saw Mills and Trading Co., Murkongselek and the Assam Railways and Trading Co., Margherita. These two companies produced annually 7,20,000 tea chests, besides other types of plywood. They have the advantage of nearness to timber supplies and being in the tea packing area, they have a near market as well. The third factory was on the Malabar Coast. The Standard Furniture Co., Kallai. This produced mainly large size sheets, with a capacity of 3,000,000 sq. feet per annum. It is well situated with regard to timber supplies, and has also the advantage of cheap labour available on the West Coast. Their products have successfully competed with the imports, in the matter of quality and price.

B.—In War-Time

The Defence Department required, in addition to the ordinary trade quality plywood of much superior type for the construction and repair of aircraft and marine units. The production of this superior type of plywood

was commenced in India after the outbreak of war, and has since been successfully established. Due to shipping and other difficulties, imports of plywood decreased to a great extent, thus affording scope and attraction for a number of factories to spring up in India. At present there are 27 factories with a potential production capacity of 97 million sq. ft. per annum. Of these, five are on the Malabar Coast, two in the Punjab, four in U.P., seven in Calcutta, two in Assam and one in Mysore. Not all these factories are producing plywood to their full capacity. Some are still in the process of being established. The total production of plywood in India was expected to reach the rate of 60 million sq. ft. per year at the end of 1943, but due to the shortage of coal and transport difficulties, this target has not yet been reached. As more factories are coming into operation, it is expected that in 1944, India will produce about 60 million sq. ft. Among the new factories which have been started since the outbreak of war, the chief are the Standard Furniture Co., Chalakudi (Cochin State), Travancore Plywood Industries, Punalur (Travancore), Malabar Plywood Works, Feroke and the Mysore Plywood Corporation, Ltd., Yeshwantpur (near Bangalore). Most of these have installed Indian-made machinery. Two factories are under construction in Bombay Presidency, one at Supa and the other at Dandelie. Of the 6 plywood factories in U.P. and the Punjab, the Sitapur factory alone is doing well. It is the only factory in India producing resin-bonded marine and aircraft quality plywood. It has good foreign equipment and technical personnel, and its only handicap is that it is not well placed with regard to timber supplies. The Calcutta factories also suffer from this handicap.

The total demand for plywood in 1943 was estimated to be about 120,000,000 sq. ft. This included 6 million tea chests, 4½ million for export trade and 1½ million for internal use.

The proportion of tea chests requirements is roughly 82½ per cent. in North India (Bengal and Assam) and 17½ per cent. in South India. But so far as the plywood factories are concerned, they are in more or less reverse proportion. Casein is the main ingredient of the glue required to make commercial plywood. It is a by-product of skinned milk. It is made in places, far away from the cities and towns, where milk is available and where, after butter is taken out, skimmed milk has practically little selling value, and from where its transport to the cities is not possible, on account of the risk of souring. About 1,120 tons of casein are in use in plywood production. The manufacture and use of proteins as a substitute is growing more popular. Tatas are already producing protein on commercial scale and some of the plywood factories are arranging to put up their own protein manufacturing plant. The use of protein brings down the cost of glue.

It has been observed that the quality of the chest plywood put on the market in recent times has been very poor. Several packages have completely given way even before shipment from Indian ports. The main reason for this is the want of technically trained workers. In fact there are very few people in the country who really know the correct technique of plywood making. Plywood produced on the cottage industry basis at and around Calcutta is also of inferior quality.

Government have imported from U.S.A. several lathes and other auxiliary machinery. This will be split up into a number of small units and allotted mostly to suitable existing factories to stabilise and step up production.

Owing to restricted imports and large demands from the tea trade, Indian producers started raising the prices of indigenous plywood. This has compelled the Government to invoke the Defence of India Rules to get supplies from the factories at reasonable prices. The supply Department has placed contracts distributing them as widely as possible and leaving a good portion of the production for the tea trade and the civil market.

C.—Post-War

Even after the war, if the factories produce the right type of plywood, there should be no difficulty about demand. The main requirement of commercial plywood is from tea trade which will still be there after the war. Due to large quantities of good timbers having been used up in war activities, there will be greater need and tendency to using plywood where formerly solid wood was being used. Communication by air will come into greater vogue and there will be demand for the high grade resin-bonded plywood for the aircraft and marine departments.

Many of the large concerns have paid attention to the question of availability of raw materials before putting up their factories. The small units which have started work at wrong places will die a natural death or will have to shift to more suitable places after the war is over. Among the latter come mostly the factories located in and around Calcutta. Labourers have to be trained, and it may be desirable to send selected persons abroad (*e.g.* U.S.A.) for training in the best plywood factories there. India may also have to import some machines which have not successfully been made here as yet, such as hot plate press and high frequency set. Lathes and other machines can be made in India and their manufacture can be improved when the better equipped workshops become free from war work.

35. WOODWARE

A.—Before the War

The manufacture of woodware articles, such as furniture, tool handles and helves, was being carried on by a large number of people, working wholtime and part-time, in their homes or in small factories. This industry, organized mostly on the small scale, is an intrinsic part of village life. Very little development had taken place in concentrated manufacture of woodware, except by a few units located in the larger towns, producing packing cases for articles like chemicals, boots, footwear and tinned food, locally made, and for distribution of similar goods imported. Apart from the tea industry using imported tea-chests, India's needs of woodware were wholly met by home production.

Woodware made in India can be grouped under three classes:—(a) Fashioned material like packing cases and crates, furniture, tool handles and helves, bamboo articles including tent poles and bamboo matting, barrel for wet goods and dry goods, straw board and other material for cartons and light containers and basket work; (b) Technical equipment like shuttles for spinning, bobbins, reels, spindles, battery separators, materials for paper making, plywood, and bridging and construction materials; (c) Unfashioned articles like poles for electric transmission, telegraphs and telephones, railway sleepers, firewood and charcoal.

The major share of India's production of woodware is consumed in the villages. The demand for woodware in India is uneven as between places, because of the irregular distribution of forests. In some places, like the Punjab, U.P. and Sind and the drier parts of Madras and Bombay, even fire-wood is so scarce that cow-dung is used as fuel. But the damper areas like Assam, Bengal and Malabar coast have rich forests abounding in timber and bamboo. Such areas neglect poor quality timber which are precious elsewhere. Special markets have been built up in many places depending upon local skill in carpentry and the supply of good timber, e.g., Kartarpur in the Punjab, Bareilly in the U.P.; and peace-time activities in the ordnance factories such as Gun Carriage Factory at Jubbulpore and the Harness and Saddlery factory at Cawnpore. Certain other areas are specialising in artistic production, e.g., rose-wood and sandalwood ornaments and carving in Mysore, walnut carving in Kashmir and toys and dolls in Madura. Such centres also have a reputation for hereditary skill in woodworking. But in many other parts with plentiful supply of wood, skilled labourers are rare; for instance in C.P., in the midst of one of the hard wood areas, one firm alone (Bellarshah Timber Syndicate at Chanda) has set up any high standard of skill in woodwork. In some provinces notably Bihar, U.P., Madras and in the Travancore and Cochin States, the manufacture of helms and tool-handles on a cottage industry basis has been built up. Bihar is believed to have given the best results in cottage woodware industry. The development of such industries will be facilitated by having a wood-working factory as the centre for issuing half-wroughts to the craftsmen for further fabrication. The best example of a local factory supporting a cottage industry is seen round the Chalakudi Saw Mill in the Cochin State.

B.—In War-time

The production of woodware has expanded considerably as a result of direct war requirements and indirect demand due to increased activity in the building of houses and offices. The biggest single peace-time user of timber is the Railway and its demand for sleepers has now been co-ordinated with the war requirements for articles like tool handles, charpoys, hospital furniture, tool chests, skids, levers, handspikes and similar military stores. There is virtually no civil export of timber from India at present, and most of the demands formerly met by imports of Burma and Siam teak have now come to depend on local timbers. Exports on Defence account, on the other hand, reached enormous figures, particularly the export of hutting timber to the Middle Eastern theatres of war during 1942. Since then, however, the amount of such timber exports has been reduced owing to the greatly increased demands for both military and civil requirements in India itself. In the course of this war, the type of articles asked for has altered radically; for instance, early demands were largely for collapsible furniture for the Middle East, but subsequent demand has been mostly for packing cases and tent poles. Production was at first mostly concentrated in the Punjab. But with the increasing difficulty of transporting the manufactured articles and the shifting of delivery points to the South and East of India, the Punjab has lost the monopoly in production, which it had built up largely through the faculty of its people for improvising simple machinery, such as lathes and saw mill benches. One of the early war developments was the establishment of the manufacture of band saw mills at Sialkot. These Sialkot bandsaws are in use all over India, and are worked by small detached electric motors of 3 to 5

H.P. India, however, is still dependent on imported steel ribbons for the band saws. To expand saw milling capacity, American machinery has been imported and established at Jhelum. Another example of clever improvisation of machinery is seen in the Sunderdas Saw Mills in Bombay, which have been successfully switched on from the production of light furniture to the mass production of ammunition boxes.

Unlike in other countries, the timber available in India is in most cases not seasoned. This handicaps the development of Indian woodware industry, and much of the criticism levelled against Indian woodware production by the military authorities is due to the fact that unseasoned timber is used. Burma teak, no doubt, can be used with very little seasoning; but Indian timbers require a seasoning period after the log has been broken down into planks and before these planks can be used in furniture, etc. The amount of shrinkage which takes place in a plank during the drying stage may be as much as 15 per cent. of its width. Recently seasoning kilns have been established in the larger Government Saw Mills in C.P. and the Punjab, and the Forest Research Institute has helped a number of private firms to set up their own kilns, chiefly in the Calcutta area. The use of kilns, however, is still in its infancy in India, and until the value of seasoned timber is appreciated and a preferential price is allowed for seasoned timber as opposed to green timber in manufactured articles, the position is not likely to improve. Even the supply of green timber has been getting scarce with the progress of war, and Government have had to supply suitable timber at controlled prices from the Forest Department depots for the manufacture of woodware required by the Defence services. Since the difference between the Government controlled price and the free market price is considerable, the manufacturers are now more eager than formerly to avail themselves of this concession.

The training of skilled labour has been one of the chief difficulties in expanding the woodware industry. The chief centres for training are the provincial handicraft schools, e.g., Robertson College at Jubbulpore, and the U.P. and the Punjab Governments' Wood Working Institutes at Dehra Dun, Bareilly and Jullundur. The only other source of trained workers is the ordnance factories, *viz.*, the Harness & Saddlery Factory, Cawnpore, and the Gun Carriage Factory, Jubbulpore.

C.—Post-War

Much of the woodware output at present going into war orders can readily be absorbed in the civilian market with only minor modifications in design. The biggest single item of woodware at present is probably ammunition boxes. Just how far the new civil trade developments will require this amount of packing material remains to be seen, but a decrease in the rate of consumption of this inferior type of timber will be welcomed by the forest authorities as the country is being rapidly denuded of its reserve stocks of standing trees. This applies not only to large forest reserves where cutting is still under rigid control and a reserve for the future has been ensured; it applies more definitely to the village supplies of hedge-row and road side avenue timber.

The future of small-scale industry for woodware is only assured for the few localities where hereditary skill is combined with an assured supply of good timber. The future for such areas is good, owing to the rise in the standard of living and the consequent larger demands for all sorts of small wooden articles; many returning soldiers trained to similar trades can be absorbed in such trades.

The number of highly skilled persons in the industry is not large and changes from war to peace are not likely to cause any serious unemployment amongst such people who can be readily re-absorbed from the concentrated saw mill industry of war-time to the more scattered peace-time developments that are likely to take place.

With regard to future supplies of forest produce, each provincial Forest Department has got its own technical staff for periodic revision of forest working plans which lay down the quantity of timber to be felled over a period of years, usually 10 or 15, for each large block of forests. To meet urgent war-time demands, the principle of equal annual yields over long periods has, to some extent, been scrapped in order to allow a bigger yield, and Provinces must be prepared for a period of recovery during which the high revenue figures now ruling must be foregone. As said above, the over-felling now taking place is largely concentrated upon hedge-row timber and timber in the private zamindari holdings, over which the Forest Departments have no control. To meet the heavy deforestation, now taking place in private lands, the attention of Provincial and State Governments should be drawn to the need for larger replanting and afforestation programmes.

- 36.—BODY BUILDING (VEHICLES)

A.—Pre-War

Before the war, the body-building industry in India was rather undeveloped. The Ford Motor Company and General Motors at Bombay used to import their commercial vehicles into India in 'completely knocked down' condition and assembled the chassis in their plants in Bombay. Ford Company had assembly plants in Calcutta and Madras also. The chassis was then distributed to their various dealers throughout India, who, in turn, when effecting the sale, made their own local arrangements for the construction of the requisite type of body. In September 1939, Messrs. General Motors installed plant and machinery in their Bombay works for the construction of various types of commercial bodies. Ford Motor Company had no such workshops for body construction.

B.—In War-time

The rapid expansion of the Army in India necessitated a fairly large programme of body-building for vehicles for unit equipment purposes. To meet this demand, it has become necessary to expand body-building production in India. The Body-building industry now is mainly located in Bombay, as the two main chassis assemblers' main plants are established there. The body-building plant of General Motors has been switched on to the production of army vehicles. In Calcutta and Madras also (where Ford Motor have their assembly plants), established motor firms were approached and encouraged to lay themselves out for the production of Army bodies. Messrs. General Motors quickly expanded their small body-building organisation and in 1940, this Company together with other motor dealers who had entered body production was capable of an output of approximately 1,000 bodies per month.

In 1941, to meet an expanded programme, production was increased, and body-building was started in Calcutta, Madras, Delhi and Lahore. In all cases the firms selected were those established in the Motor trade

in India prior to the outbreak of war. Production figures of later years are given below:—

FIGURES OF VEHICLES' BODIES SUPPLIED TO THE DEFENCE DEPARTMENT.

Year.	No.
1940-41	10,011
1941-42	31,843
1942-43	41,278

Since the war started, till February 1944, 132,572 completed vehicles have been delivered to the Defence Department, and the monthly production is maintained at 5,000 to 5,500 bodies per month.

The supply of the four essentials for Army body-building, *viz.*, steel, timber, canvas and hardware (nuts, bolts, screws, etc.) came under Government control in 1941. With the exception of certain items of hardware like coach bolts, nuts, wood screws, and machine screws, all items are available in India. The steel is supplied by Tatas, the timber through the Timber Directorate under Government control, and the canvas by mills in Calcutta, Bombay and Madras; the hardware excluding the items aforementioned, comes from indigenous manufacture.

The expansion of the industry has meant increased employment. Further, large numbers of workmen are trained in the fabrication of the various materials required in body-making.

C.—Post-War

After the war the industry may contract considerably; for the present output is far in excess of the peace-time needs. Hence unemployment is likely to occur. But a good number of the employees, who are mostly metal-workers, wood work maistries, darzis (for canvas fabrication) and fitters could be absorbed in other expanding industries.

VI.—OTHER INDUSTRIES

37.—CYCLES

There were two plants engaged in making cycles, one an assembling unit and the other a manufacturing unit. Encouragement for the expansion of the industry was offered after the outbreak of the war, with a view to saving the shipping space and encouraging the indigenous manufacturers to meet the requirements of the Defence Services. This led to the establishment of a third plant of manufacturing unit by Messrs. Birla Bros. The two companies now producing cycles are the Hind Cycles, Ltd., Bombay, and the Hindustan Bicycle Manufacturing Corporation, Ltd., Patna. The Bombay firm is the bigger concern, but the Bihar Company has the superior advantage of nearness to coal and steel which are the principal raw materials. The two concerns manufacture all the cycle parts except free wheels, chains, spokes and nipples, and steel balls. Government have given facilities for the import of these goods. Assistance was also rendered to the Hind Cycle Company for importing steel strips for frame; but it is now understood that Indian steel will serve the purpose. Licences have been issued for the steel required to manufacture the quantity of cycles ordered by the D. G. S. Certain controlled chemicals like zinc sulphate, oxygen, acetelyne (and sulphuric acid in the case of Hind Cycles, Ltd.) are also being given to these firms by the Government to the extent of the requirements needed to meet the Government purchases. The cycles produced in accordance with the specification laid down by the Director of Armaments compare favourably with imported cycles.

In 1942 Hind Cycles produced 17,641 cycles and the Hindustan Cycles produced 4,100 cycles. Of the total production, Hind Cycles sold 6,001 to Government orders and 8,365 for civilian use. The annual estimated output of Hind Cycles is 25,000, and of the Hindustan Cycles, is 15,000. The total output is capable of being increased to one lakh a year. At present production is low due to experimentation and alteration in design.

After the war, the entire production of the two firms will be available for the civilian market. The whole production will have to be sold in this country except for a small export to Ceylon and other adjoining countries. It is very doubtful whether the Indian firms will be able to compete with the foreign made cycles, at least so far as export is concerned. This gloomy prospect for the Indian cycle industry is mainly due to its small scale of production. The normal economic unit for production of cycles should (it is considered) be in the vicinity of 2½ to 3 lakhs cycles per year, if not more. The production capacity of the Indian plants is far below this minimum. In Europe, Great Britain is the main producer of cycles and even America used to import cycles from Britain. Cycles are not manufactured as one complete process by any firm in England, but various parts like spokes, frames, rims, chains, etc., are produced on mass scale in various firms and the small firms purchase these various parts and assemble them. This enables a most economical production of cycles. It is to be noted that, before the war, a good British made cycle was imported at about Rs. 40 in India without customs duty, while the Japanese cycles were imported at somewhere in the vicinity of Rs. 15 per cycle including customs duty. It is doubtful whether the Indian manufacturer would ever be able to sell at Rs. 40 each, with the present methods of production, as each firm is trying to manufacture all its parts like spokes, wheels, chains, rims, frames, etc., and then assemble them, which is not an economical proposition. Unless the cycle manufacturing interests pool up their resources to establish a plant with a production capacity of three lakhs of cycles a year, which is considered to be the likely normal peace-time demand of the country, it is doubtful whether we will be able to compete even with the British, not to speak of the Japanese imports.

38.—RUBBER

A.—Pre-War

Before the War, the Indian rubber manufacturers were consuming only a part of Indian raw rubber (6,952 tons in 1939 out of a total production of about 14,000 tons); the balance was exported. The most important section of the rubber manufacturing industry is tyre-making for motor vehicles. This today accounts for, between 80 per cent. to 90 per cent. of India's rubber consumption, and for a similar percentage of the capital invested in the industry. Of the other important raw materials required for the manufacture of tyres, cotton is obtained from Egypt and the Sudan, and is processed into tyre manufacturing cord in India, and compounding materials like carbon black, sulphur, etc., are obtained from the U.S.A. The first tyre manufacturing plant was established in India in 1935 by the Dunlop Rubber Company, and was followed in 1939 by a plant in Bombay established by the Firestone Tyre and Rubber Co. Both the companies and other distributing companies for which they manufacture tyres had previously been operating in India for a number of years, importing tyres from U.K. and U.S.A. Before the War the production of these two companies was sufficient to meet India's tyre requirements.

The establishment of the tyre manufacturing industry in India was made possible by the operation of the International Rubber Restriction:

Agreement (1934) which, by controlling the export of rubber by fixed quotas, raised the World price of rubber and maintained it at a level considerably above the minimum economic price. The restriction of the export of rubber by quota left a large production of the production of Indian rubber available for internal disposal. Consequently, the new rubber manufacturing industry in India was able to buy rubber free of export quota at a price considerably below world levels, and thus enjoyed very important measure of 'protection.'

Other rubber manufactures in demand in India were being imported before the war, mostly from Japan, except one or two items, *e.g.*, some kinds of rubber-covered cable and certain classes of railway rubber goods and footwear.

B.—War-Time

With the loss of Malaya, Java, Sumatra and Burma in 1942, India has had to rely on her manufacturing facilities for essential rubber goods like tyres, mechanical and water-proof sheetings, rubberised fabrics, hose of every description, ebonite and moulded goods, etc. The development of many of these items was stimulated by the restriction placed on the manufacture of other non-essential rubber items, such as rubber footwear for civilian use, sports goods, etc., and many of the factories previously occupied in producing foot-wear have been expanded and developed for the production of these general industrial and mechanical rubber goods. This industry is, however, in general not soundly based as most of the plant is improvised or obsolete, and the majority of the goods produced do not come up to the imported standard, although there has been a steady improvement in quality. The tyre production has increased considerably and the two plants (of the Dunlop and Firestone Companies) have been substantially expanded to meet war demands, the main addition being in respect of 200,000 giant tyres of special sizes required for the army. These expansions are in the form of additions to the existing plants and take advantage of the installations and technical personnel already available. A special plant has been installed for the production of aeroplane tyres.

At present there are 115 rubber manufacturing units located mostly in Calcutta and Bombay and to a small extent in Sialkot (Punjab). Of the total Indian rubber manufactures, 70 per cent. goes to War orders. The total Indian rubber consumption for 1944 is estimated at 17,000 tons. Seven to eight thousand persons are employed in the rubber manufacturing industry. The total capital investment may be four to five crores of rupees. Steps are being taken to instal two reclaim plants, as a war measure, with a capacity of 6,000 tons of reclaimed rubber per war. Sufficient scrap rubber chiefly in the form of old tyres is expected to be forthcoming. These plants are also intended to treat scrap received from the Middle East on behalf of H.M.'s Government.

C.—Post-War

At present India is virtually self-supporting for all rubber goods; the present capacity of the plants is in fact greatly in excess of any conceivable post-war requirements. After the war Indian industry will have to face foreign competition, especially from U.S.A., U.K., and Japan. Now that the Rubber Restriction Agreement is in abeyance, the Indian manufacturers will have to pay approximately the same price for rubber as elsewhere. This means that the Indian rubber industry will have to face greater difficulties in the post-war period than in the pre-war.

39. CUTLERY

A.—Before the War

This industry has been pursued on a small scale by the village blacksmiths from times immemorial. In recent times larger units of production have come into being, owned by enterprising smiths or others. The lines of production largely conformed to the rural requirements—namely, knives of various kinds, spoons, butcher's implements, farm implements like sickles, etc. Factories worked with steam or electric power were also started and these made cutlery of the modern type and surgical instruments. But such production continued to be small for long, and the large proportion of the pen-knives, table-knives, scissors, razors, spoons and forks, etc., used in cities and towns were imported.

Centres of production.—Production was scattered throughout the country, but there were certain areas which enjoyed notable hereditary skill; for instance, Aligarh and Moradabad in U.P.; Nizamabad and Wazirabad in the Punjab. The bigger factories are located in cities like Calcutta, Lahore and Bombay.

Raw material.—Imported steel was largely used and only a small proportion came from the Tata's and other Indian factories. In rural areas, some kind of steel was made by the indigenous process by skilled blacksmiths and ironsmiths.

B.—In War-Time

The war created a large demand for spoons, forks, table-knives, scissors, razors (including safety), butcher's implements, etc. Therefore this demand had to be met in India. But as imported steel was not available, the demand had to be met mostly by Tata Steel or scrap steel. The producers had to adjust themselves to the manufacture of the classes of goods just mentioned and this led to greater standardisation than formerly. The Supply Department dealt with some of the larger producers. In other cases orders were placed with contractors, who purchased partly wrought articles from rural areas, and got them finished in workshops maintained by them.

Thus production increased. It is not possible however, to give any reliable estimate of the total production. The total Defence demand in 1943 came to 5,800,000 pieces valued at Rs. 96 lakhs. No data are available for estimating total production, but it may be about double this quantity.

The demand for 1944 is only for 1,600,000 pieces of cutlery, valued at Rs. 23 lakhs, *i.e.*, only 30 per cent. of the 1943 demand.

How the excess capacity will be employed is a matter for enquiry.

C.—Post-War Adjustment

The goods now made to meet Defence demands are also suitable for civilian markets, except that a greater variety may be required. There is not much adjustment to be carried out.

It remains to be seen whether the new lines of production will be able to maintain themselves in a free market after the war. This will depend upon the availability of imports, their comparative price position, etc. One achievement to be noted is that Tatas and other internal producers have come to meet the demand for the classes of steel required for cutlery. Much experience has also been gathered in re-melting scrap steel. In this way the Indian Industry may do without any large imports of steel for cutlery.

It remains to be seen also whether the total demand for cutlery of the modern type has increased. There are indications that there has been an increase. This will be a favourable factor in the case of this industry.

40.—STONEWARE AND POTTERY

Stoneware.—Before the war, the Defence Services requirements for stoneware were being met from imports from U.K. which were cheaper and had better finish than indigenously manufactured ones. But India's production capacity for these items was large.

As a result of the war, and consequent shipping restrictions, the indigenous production of stoneware had to be developed principally to meet the Defence Services demands. Now stoneware pipes, bottles and acid jars of various capacities and designs are being supplied mostly by the following firms:—

(1) Gwalior Potteries .. .. .	..	..	..	..	..	New Delhi.
(2) Reliance Brick and Pottery Co., Ltd. .. .. .	..	..	..	..	..	Calcutta.
(3) Cochin Potteries .. .. .	..	..	..	..	..	Chalakudi.
(4) Bengal Potteries .. .. .	..	..	..	..	..	Calcutta.
(5) Parashuram Potteries .. .. .	..	..	..	..	..	Morvi.
(6) Parry & Co.'s Potteries .. .. .	..	..	..	..	..	Ranipet, Madras.
(7) Perfect Pottery .. .. .	..	..	..	..	..	Jubbulpore.
(8) Burn & Co.'s Potteries .. .. .	..	..	..	..	..	Jubbulpore.

Nearly 300,000 acid jars are needed in India annually, more than half of which are supplied by Parry & Co.'s Potteries at Ranipet. The demand for stoneware bottles (stoppered) comes to about 20,000 a year, and the bulk of it is supplied by Bengal Potteries, Gwalior Potteries and Parashuram Potteries. Stoneware pipes are also in large demand owing to extensive building constructions necessitated by military needs during the war and are mainly supplied by Perfect Pottery, Jubbulpore, Mysore Stoneware Pipes, Burn & Co.'s Potteries and Parashuram Potteries. The demand for pipeware is estimated to be about 8,000 tons per year, and it is also met from indigenous production now.

Crockery.—Manufacture of crockery in India has been of recent origin. Its development in pre-war period was hampered by keen competition from Japan, Czechoslovakia and Staffordshire in U.K. Of the Jap competition was the greatest. The superior quality and lower prices of the imported crockery killed the nascent industry in India. The demand in India for crockeryware was also not large, but limited to better-off classes. Even then, Gwalior Potteries and Bengal Potteries, and later on Parashuram Potteries, and a few small concerns developed a limited trade in crockery within the country. The indigenous production was limited to a few items like cups, saucers, tea pots, small plates, basins, jugs, etc., which are in common use. Most of the demand for these came from restaurants, etc., where quality ware is not insisted upon. Besides these, a large quantity of fancy jars used for pickles, etc., vases and fancy articles were manufactured in India to meet a growing civilian demand.

Because of the paucity of demand for Indian made crockery and keen foreign competition, some of the progressive potteries, before the war, switched on to the manufacture of electrical insulators, telegraph insulators and other porcelain ware for which there was a large and growing demand from Government and Electricity Supply Companies. This development has been decent and is accelerated in war time by the stoppage of import of insulators and other porcelain electrical goods.

The main suppliers of crockery ware now are the following:—

(1) Bengal Potteries .. .. .	..	..	..	..	..	Calcutta.
(2) Gwalior Potteries .. .. .	..	..	..	..	..	Gwalior.
(3) The Government Ceramic Factory .. .. .	..	..	..	..	..	Kundara (Travancore).
(4) Parashuram Pottery Works .. .. .	..	..	..	..	..	Morvi (Nazarbagh).
(5) The Government Porcelain Factory .. .. .	..	..	..	..	..	Bangalore.
(6) The Bengal Porcelain Company .. .. .	..	..	..	..	..	Calcutta.
(7) Art and United Potteries .. .. .	..	..	..	..	..	Calcutta.

Of these, the first one and the last three potteries have to a great extent switched over to the production of electrical insulators which are in large demand at present. The Defence Services requirements of crockery were originally being met from imports, but during the war period, these had to be met from indigenous sources, and production developed to that extent with the above mentioned potteries. The total annual demand is estimated at 1,500 tons of crockery ware. In order to develop this capacity, a modern plant with tunnel furnaces worked by producer gas was installed in one of the biggest potteries in Calcutta, with the assistance of the Supply Department. Another pottery in Calcutta had to be taken over by the Supply Department for complete control of the production of insulators and crockery ware. The project of a third up-to-date pottery on similar lines is under construction in the Delhi area. The productive capacity has been increased with Parry & Co.'s potteries at Ranipet and Government Porcelain Factory, Bangalore expanding their production with the help of their up-to-date plant equipped with tunnel furnaces.

In the post-war period, the established production can very easily be switched over to the production of wares suitable for the civilian demand, with very little modification, as the stores now being produced for Defence Services demands are similar to those for the civilian market. Moreover it will take a long time for the Japanese or Continent competition to come up to the same level as in pre-war days, and technical developments made possible during war will help in maintaining the production of stoneware and crockery after the war. The handicaps of coal and transport difficulties experienced during war will also be eased in the post-war period and therefore the prospects of the industry are good. Nevertheless to stimulate internal competition and stabilize production, it may be necessary to go for modern plants with up-to-date equipments for large scale production, and such developments are likely to take place in the case of all well-organised and established potteries. Another marked tendency of recent origin is to develop the pottery industry near the coal fields and sources of clay.

Sanitaryware.—Prior to the outbreak of the war, the Government requirements of sanitaryware were being met almost in full by importation, as the indigenous production of good quality sanitary stores was negligible. The following are the import figures of sanitaryware in pre-war and war years.

Import figures of sanitaryware—(value in rupees).

Article	1936-37	1937-38	1938-39	1939-40	1940-41
Sanitaryware	8,57,444	9,75,046	8,80,437	9,26,257	6,92,553

Both in war years and before the war over 80 per cent of imports of sanitaryware came from the United Kingdom. The Continental countries,

Japan and American were also importing though in very small quantities. It was only in 1942 when the shipping position became acute that there was an appreciable fall in the importation of sanitaryware.

Even though imports continued in appreciable quantity in war years the industry has been developed in the country, and about 61 firms are now producing sanitaryware. Now all the Government demands are being met from indigenous sources. In 1943, Government demands for various types of sanitaryware came to about 5,103 pieces, of which only 1,496 pieces were supplied by Indian industry. The big disparity between the quantity demanded and that supplied is due to the large number of rejection of supplies during inspection. Moreover the scarcity of coal and transport difficulties are holding up production considerably.

The industry is now only in an embryo stage, and in the post-war period it is likely to face very severe foreign competition.

41. ENAMELWARE

A.—Before the War

Before the war, the enamelware industry in India was in its infancy. There were three important firms, *viz.*, Bengal Enamel Works, Palta; Sur Enamel Works, Calcutta; and Indian Enamel Works, Bombay. Production began about the year 1922.

The two major handicaps under which the Indian industry suffered were **firstly** its lack of knowledge of the practice side of manufacture, and **secondly** the increasing Japanese competition. The Japanese were able to dump enamelware in India because of their national policy of procuring raw materials, particularly black sheets, at much cheaper prices than those prevailing in India. Industrial chemicals such as borax, soda ash and cryolite were also imported into Japan duty-free. This competition eventually led to the total collapse of the hollow-ware manufacturing business in this country. Indian industry, however, revived with the outbreak of Japan's war with China.

B.—In War-Time

The war has given a great fillip to the industry because of the heavy demands from the Supply Department and the Government Medical Stores, with the result that quite a number of production units have sprung up. There are about 12 firms now producing enamelware—2 in Bengal, 5 in Bombay, 1 in Madras, 3 in the Punjab and 1 in Delhi. The Bengal Enamel Works is the greatest supplier of enamelware to the Government. They have 12 muffle furnaces, of which only four are now working, the rest lying idle for want of coal. The other big firms are the Sur Enamel Works, Calcutta, Vizir Enamel Works, Bombay, and Leslie and Company, Bombay.

Borax, sulphuric acid and other chemicals, steel sheet and coal are the raw materials that go into the manufacture of enamelware. Due to the acute shortage of these raw materials at present especially of coal, firms are not able to produce to their full capacity. The War Resources Board has allocated only a small quota of coal to this industry; efforts are being made to increase the quota. There is ample capacity for the existing firms to meet the war demand, and if assistance is given in procuring raw materials, there would not be any difficulty in meeting civilian demand as well.

C.—Post-war

The industry is likely to expand further after the war for catering to the home market, and may even be able to develop a flourishing export trade with China, Malaya and other Eastern countries, giving employment to an additional 10,000 people. These workmen would be much above the unskilled labour class and would earn good wages. But if Japan is left free to dump enamelware products throughout the East, the above prospects may disappear.

42. BRUSHWARE

A.—Before the War

The brush-making industry existed in India before the war, on a small scale, as an offshoot of the large and thriving trade in bristles. Large quantities of bristles produced in India went as exports; in 1934-35 the export figures of bristles came to 4,406 cwts. 80 per cent. of it going to the United Kingdom. The market for bristle is centred in U. P. The price of shorts, the popular form of Indian bristle was, before the war, Rs. 2-8-0 to Rs. 3 per seer. Horse hair and Mixed Fibre are also required as raw materials mainly for the brushes for the Army. Mixed Fibre includes Bahia Bass, Mexican fibre and Lassine. All these were obtained by importation. There are indigenous substitutes for these fibres, like kitul, as substitute for Bassine and Bahia Bass, and Palm fibre for Mexican fibre, but they are more flexible and therefore inferior. Wood and wire components, the other raw materials are locally available.

The manufacture of brushes is localised in Cawnpore, Agra and Bareilly. Brushware, Ltd., Cawnpore, engaging only 200 labourers and having a sale of only Rs. 83,000 for six months ending May 1939, was responsible for 75 per cent. of India's total manufactured brushware. Bevis & Co. of Cawnpore was another important manufacturer of brushes, though they were mainly engaged in the production of cotton goods. The Indian Army was obtaining its peace-time requirements of indigenously manufactured brushes from these two firms. And in India the consumption of brushes by the Army is far more than that of the civilian market. For the supply of certain kinds of brushes like tooth brushes, lacquer brushes, writing brushes and goose brushes, India was still dependent on imports to a large extent. No indigenous substitute could be found for lacquer or writing brushes, which are made of the fine hair known in the trade as sable, camel or badger. Tooth brushes were being produced in India, but in quality they could not compete with imports. Apart from the above two companies at Cawnpore, there were many bazaar firms who could in emergency produce hand-made brushes of fair quality. Large quantities of such brushes were made for the Government use during the last war.

The chief kinds of brushes made in India were the following; Brushes blacking, brass, clothes, hair, polishing, shaving, dusting, paint oval, plate, sash tool, stencil, Tar short and long, varnish, watchmakers, bedpan, feeder, flue, scrubbing, sweeping dandy, harness, horse and nail.

B.—In War-Time

With the outbreak of war, Indian bristles have been in great demand mostly for the army and all exports of bristles from India have now been stopped except under control to the U.K. and the U. S. A. Restriction on the use of bristles is also contemplated in India. The Army is also being urged to economic as far as possible in the use of brushes made of bristles. The

price of 'shorts' (Indian bristles) has been fixed by the Government at Rs. 7 per seer. The village owner of the pig is thus getting a good deal more money for one of its by-products. Besides Messrs. Brushware, Ltd., many smaller manufacturers have developed their productive capacity or gone into new types of production, which used to be imported previously. This has been possible in this industry, because the relatively small amount of machinery required can be manufactured in India and almost all machine parts are locally obtainable. The training of labour is merely a matter of time and reasonable skill in the various processes does not take a long time to build up: A few of the special types of brushes so developed are:—

1. Brushes, Wire, for Welding Sets.
2. Brushes, Writing, Sable, Hair (with indigenous material).
3. Brushes, Writing, Camel Hair (as substitute for Sable Hair).
4. Brushes, Vulcanizer, Flux, small.
5. Brushes, Aluminium, Soldering.

The main raw materials (wood and bristle) are available in this country, but certain fibres, hair, wire and China bristle are still being imported. The following table shows the quantities of certain raw materials used during 1942 by the industry.

Raw material	Quantity obtained indigenously	Quantity obtained by import	Source of Supply.	Total
Fibre (Tons)	11½	..	..	11½
Wood (C. Ft.)	26,111	..	..	26,111
Wire (Tons)	15½	1½	England.	16½
Hair (Tons)	3½	15 lbs.	..	3½
Bristle (Tons)	152	12	China.	164

The labour force of Brushes, Ltd., has increased from the pre-war figure of 200 to 2,000, and the sales of the Company for the six months ending May 1942, amounted to Rs. 28 lakhs (pre-war figure Rs. 83,000). Current orders to the factory included 2,800,000 shaving brushes, 2,500,000 boot brushes and 1,600,000 hair brushes.

The total demand of brushes by the Supply Department came to 2,427,342 (number) in 1943. In 1942, the total orders placed by the Supply Department with Messrs. Brushware, Ltd., amounted to Rs. 1,69,00,000. The workers in the factory all piece-workers; they received 20 per cent. more work to do in 1943 at higher rates than in 1942. In the absolute sense, wages may be low in this not very highly skilled work, but relatively they have risen from 6 to 9 annas a day for a woman and from 10 to 15 annas a day for a man.

43. SURGICAL INSTRUMENTS AND APPLIANCES

In peace-time, the indigenous production of Surgical Instruments was small and limited in range.

The industry was located mainly in Sialkot and Bombay. The Sialkot firms relied very largely on manual methods of production and crude methods of heat treatment and electro-plating. The Bombay firms were better equipped with machinery and produced a better quality instrument. All firms, however, lacked the technical knowledge necessary for the correct selection of steels, and forging, finishing and heat treatment of steel. Owing to the difficulty in importing Surgical Instruments from the U. K., India was asked to rely, as far as possible, for surgical instruments on indigenous production. Late in 1941, large orders were placed with indigenous firms. The quality of instruments produced, however, was not

satisfactory. During 1942 detailed specifications of instruments were prepared. Local manufacturers, however, owing to the lack of adequate production facilities and technical experience, were unable to comply with these specifications. It was, therefore, decided to appoint a competent and adequate Development organisation. This organisation was supplied by the Controller-General of Inspection, and commenced its activities in February 1943. The first six months of 1943 were occupied in equipping factories with adequate machinery and heat treatment furnaces. By July 1943, the Industry was in a position to undertake large scale production of good quality surgical instruments.

In the latter half of 1943, approximately 30,000 instruments of first quality were manufactured monthly. This output is sufficient to meet the demand. Over 80 per cent. of the production emanates from Sialkot City. The manufacturers in that city are very appreciative of the technical assistance provided by Government and have co-operated fully in the development schemes. The firms are now equipped for surgical instrument production and have received adequate technical education and experience in the processes involved in production.

After the war, the highly efficient supervisory staff provided by Government may be withdrawn. It is hoped that the high quality of the instruments produced will still continue to be maintained.

With regard to Surgical Appliances; it has not been necessary to provide the development organisation as in the case of surgical instruments. Appliances are, in the main, of cruder construction. In view, however, of the marked success achieved in improvement of the quality of instruments, it has been decided to provide a smaller organisation to develop and supervise the production of the more important appliances.

44. ROPE MANUFACTURE (HEMP AND COIR)

A.—Before the War

The chief raw materials for ropes are Manilla hemp and maguey from Philippines, Sisal hemp from Africa, Coir from South India, Indian hemp from U.P., C.P., and the Eastern States, Bengal Hemp, Jute, and cotton. Six factories and several hand-manufacturing concerns were making hempen ropes in Calcutta and the neighbouring districts. The capital investment in the industry came to about Rs. 30 lakhs. The unit of production varied from a 2 oz. ball of twine to a 4 ton coil of rope. The making of ropes and other articles from coir is localised in Travancore and Cochin where it is largely a cottage industry, subsidiary to agriculture. All the rope factories employ machinery; some do the whole of the processing by machinery while others do the bulk of their manufacture by hand. About 3,000 labourers, mostly semi-skilled, were employed in this industry, in the Calcutta area alone.

It is difficult to gauge the proportion of the internal market supplied by the industry before the war. The Indian cultivators use considerable quantity of rope, but they make for themselves most of the rope they need. Nevertheless the whole output of Indian rope factories was sold in India. There were besides considerable imports from the U. K., of transmission ropes made from Manilla hemp and cotton. A cheaper variety called yellow rope was also imported from Japan in large quantities and was sold at prices scarcely higher than those at which India was importing the necessary raw materials.

In normal times, the main item of rope industry was Manilla hemp. Although in 1929, the Tariff Board recommended that there should be no import duty on Manilla hemp, such a duty was in existence right up to the outbreak of this war. This is said to have handicapped the Indian manufacturers, even though a similar import duty was being levied on ropes as well.

B.—In War-Time

Large quantities of all kinds of ropes are required for war purposes. This heavy demand has led to triple-shift working in all the factories making hempen ropes. Since new machinery could not be imported, the existing machinery is being strained to the utmost by the triple-shift working. There has been no civil export, and direct Defence service orders have accounted for 75 per cent. of the total production of hempen ropes. The extra capital involved has been obtained by the firms either by borrowing from the Banks or from the Managing Agents.

With the loss of Philippines, Manilla hemp ceased to be available and sisal hemp is used instead. But the quantity of sisal available in India is so small that imports are necessary. Indian hemp is also used mostly of the Ganjam type, though in normal times most of this material was exported. This type of hemp requires proper processing for which imported machinery is essential. Indian hemp is also used in the manufacture of camouflage nets, under the supervision of the Director of Industries, Bengal, and Registrar of Co-operative Societies in the U. P. The whole of the Bengal crop of hemp and a large part of U. P. crop were used in this way. But now, owing to the complete stoppage of all demands, many thousands of workers employed in this line of production have been disbanded.

The loss of the continental markets on which the coir industry was largely dependent led to the closing down of many coir factories, and caused large-scale unemployment of labourers on the Malabar Coast. But with the progress of war, the position improved and prices of coir ropes and other articles are again ruling high.

C.—Post-War

The ropes now being manufactured will be suitable for the civilian market after the war. But the whole of the present output may not be absorbed in India, even if the tariff on raw materials is removed and imports of ropes are restricted. This means that unless new markets are found, about 6,000 people may be thrown out of work in the hempen rope industry. The coir industry may not be affected so adversely, in case it is able to revive its export trade with the East, with the ports of Akyab, Penang, Rangoon, Saigon, Bangkok, Shanghai, etc.

At the close of the war, there is likely to be a good surplus of ropes, which might represent much more than one year's production under normal working conditions. The disposal of such surplus is a matter vitally affecting the Indian rope industry, in that such supplies may satisfy the demands of countries which would have been good markets for the Indian rope industry. This is particularly true of Burma, where the oil and transport companies need large quantities of rope. If the war surplus does not upset such markets, the demand could well be met by the Indian industry. The interests of the Indian rope industry also call for the encouragement of the indigenous production of imported fibres like Manilla and Sisal hemp.

45. BUTTONS

Buttons made of horn, bone, etc., have been produced in many parts of the country from generations past as a cottage industry. As the Army was unable to accept these buttons due to a high degree "boiling-test", nut and coconut shell buttons have been accepted as substitutes, and two firms in the Punjab Messrs. Janda Manufacturing Company, Limited, Lahore, and International Manufacturing Company, Limited, Lahore, are producing about 1,50,000 gross of buttons at the low price of one rupee per gross. The Indian nut or coconut shell could not possibly be used in buttons of bigger sizes, and we are importing East African nuts of bigger sizes for the production of buttons of sizes above 1/2".

Buttons are also made of galvanised iron in small scale units, mainly to meet the war demand. The Supply Department is supplying about two to three lakhs gross of buttons (G.I.) every month. These buttons do not however conform accurately to specifications and are suitable only for handstitching. They are of 5/8" diameter and suitable to be used on trousers. Attempts are being made by the Supply Department to establish power presses and units with a proportionately large capacity to turn out accurate buttons for machine stitching; its price, however, may be a little higher. Besides these, cotton thread buttons are also being produced as a cottage industry. There is a large demand for these in the civil market, but there is no scope of using these for army needs, as the I.M. specification does not permit their use.

After the War, coconut shell buttons and horn and bone buttons will have to meet the competition of Japan and Italy who had the monopoly of button supply in India before the War at every competitive prices. The G. I. buttons industry also will not have much scope after the war, except for military purposes.

VII. MISCELLANEOUS

46. Foot Operated Air Pumps for Motor Vehicles

Foot operated air pumps are of two kinds: (1) Hollow plunger type, (2) solid plunger and external spring type. The latter type is more economical as it requires less brass for its manufacture. The majority of the Defence Services demands is for the small car type and large lorry type. The manufacture of large lorry type pumps has been developed in India in war time, and indentors are being persuaded to accept these in the place of the small car type. The present estimated capacity of the country is about 18,000 pumps per month. More can be produced if spring steel wire of the required quality is available. The machinery required for the manufacture of pumps is simple and the process of manufacture is easy. But the demands for the pumps may fall off considerably after the war.

47. CASEIN AND CASEIN GLUE

These are used for adhesive purposes in manufacturing articles like celluloid and plastics, insulating materials, photo plates, glazed paper, oil emulsion paints, dry distempers, varnishes, rubber ground, sheets; cloth, camouflage nets, anti-gas sleeve detectors, plywood, American cloth, etc. Of these, the plywood industry is the largest user, and the demands of all other industries are comparatively small. The casein bounded plywood is used for various purposes including teachests, panelling and seats of ambulance trains and cars, body-building, repairs and construction of aeroplanes and

ships in parts not directly exposed to weather. Defence requirements of plywood also include foodstuffs containers and parachute containers and containers for airborne troops, defence buildings, etc. The total requirements of casein in India are estimated to be about 2,800 tons per month.

Casein and Casein glue are made by the various dairy farms in Gujarat, Madras, U.P., and the Punjab. It is made from milk and the difficulty of getting adequate quantities of milk is preventing the further increase in the production. Meanwhile efforts are being made (1) to import casein from countries like Argentine which have surplus of dairy products to spare, and (2) to develop the production of vegetable glue as a substitute for casein, but it is not suitable for plywood work.

The Indian casein industry is likely to survive the war, but the high quality glue will continue to be imported as in the pre-war days.

48. SPRING BALANCES

Nothing is known about the pre-war conditions of this industry. In war time, India developed the manufacture of spring balances of 4 lbs., 30 lbs., and 200 lbs., weighing capacity. But the manufacture calls for high carbon steel spring wire of different gauges (18, 14 and 11 EWG) and all efforts to make this wire in India have been unsuccessful. This has kept down the production capacity. In 1942, 33,782 balances were made in India with imported steel spring wire. But production dwindled to 2,507 in 1943, due to the depletion of the stock of imported steel spring wire.

The post-war production of spring balances (which is likely to be in good demand with increasing commerce and trade) is dependent on the prospects of developing the production of steel spring wire indigenously, for the spring balances manufactured with the imported wire may not be economical as against imports.

49. SAFETY RAZORS

HOLDERS.—Before the war, there was practically no indigenous production of safety razor holders. But in war-time the demand for safety razors for military purposes increased largely and imports having been cut off, provision had to be made for internal production. At the instance of the Supply Department, several firms in the Punjab, Bombay and U.P. took up this line of production and although the first samples of their production were not up to the mark, they soon were able to produce safety razors of fairly good quality and of different kinds.

Most of the firms manufacturing this store are now concentrated in the Punjab, but there are a few important producers in other areas also. It is difficult to estimate the total manufacturing capacity of the country, but in 1944-45, the production is expected to satisfy in full the Defence demands which come to about 2,300,000 of safety razor holders. In 1942-43, 1,38,902 and in 1943-44, 2,68,495 holders were supplied from local manufacture against Defence Service orders. The service pattern hitherto used was designed for the slotted type of blades. But now a change in design is effected so that slotted blades as well as three-holed blades can be used. This will necessitate the alteration of the dies used by the producers.

The chief raw materials required are brass and nickel for the holders, cardboard for the containers and coal for power. These raw materials are released to the firms meeting Government orders, at controlled rates and therefore the price of the holder has remained at Re. 1. This compares favourably with the prices of imported holders.

After the war competition from imports is likely, but there is no ground to expect a total disappearance of the existing producers from the field.

Blades.—Before the war India was dependent chiefly on imports for safety razor blades. Subsequently attempts were made to manufacture them from indigenous sources and certain producers succeeded in making good blades, but the chief bottleneck experienced was the lack of suitable steel strips which could not be manufactured in India. The Tata Iron & Steel Works Company, have as an experimental measure agreed to make a small heat in the high frequency furnace conforming to the special composition and roll it into sheet bars of 26" gauge. The Northern India Safety Razor Blade Works which is the principal firm in the field, is arranging to re-roll these strips into thinner sections and to the punching, griding, heat treatment, etc. This experiment, if successful, will substantially help to establish this new industry in India, even though competition is likely to be active when normal times return.

Recently the Supply Department has entered into a contract with the Northern India Safety Razor Blade Works for resharpening used razor blades at Rs. 3 per hundred blades including the packing charges. The maximum capacity of the firm for this work is 50,000 blades per month. Another firm in Lahore, the Auto Sharp Blade Company, has a capacity to resharpen 30,000 blades a month.

50. SEWING MACHINES

The industry was not in existence before the war. Even now the Defence requirements are being met mostly by imported sewing machines. One firm in Calcutta, Java Engineering Works, is now manufacturing the usual household type of sewing machines which goes mostly to meet civilian needs. In 1943, they supplied the Defence Services with 326 machines and the civil market with 188 machines. With the arrival of a new plant whose importation has been recommended, the company will be in a position to make heavy type of machines also.

51. SAFETY MATCHES

The production of matches in India has decreased with the outbreak of war. Many factories have been compelled to close down because of the shortage of imported raw materials. The Western India Match Company, Ltd., (Wimco), Bombay, is the chief producer of matches in India, with an estimated production of three lakhs of cases in 1943, each containing 50 gross boxes. The total Indian production for 1943, was estimated to be 4,20,000 cases. The same figures are estimated for 1944, also. Of this, 37,600 cases went into the Defence demand in 1943. This figure is likely to fall to 20,000 cases in 1944, and with an anticipated greater decrease of Military demand in 1945, larger supplies will be available for civil use in 1943 and 1944.

52. TOOTH BRUSHES

There were a few producers of tooth brushes in India before the war, but their output was small and the quality of their product was not on a par with that of imports. In war-time, many producers have sprung up as a mushroom growth to take advantage of the scarcity of the imported tooth brushes in the market, and the large Defence Service requirements. Up to the end of 1942, however, the Defence Service requirements were either being imported or met from the imported stock in the country. It was only after the shipping position had become very tight that heavy demands were made on the indigenous industry for Defence Service requirements.

In 1942, an order for 8 lakhs brushes was received from the Eastern Group countries, but out of this only 1,73,000 could be supplied from local production. In 1943, India's Defence Services alone required 25 lakhs of brushes. Out of this, local production at the maximum can supply about 10 lakhs. Two factors account for the difficulty of meeting the entire Defence demands from local production: firstly, service pattern tooth brushes have to be made of non-inflammable handles and for this purpose bones or horns are required. But the supply of these indigenous raw materials is not sufficient. Adequate equipment for the sterilization of the bristles to the high standard required by the Army is also lacking. Secondly, even though some of the firms have enough capacity for supplying in full the Defence requirements, their prices are prohibitively high. Hence the production of all the Indian firms is not made use by the Supply Department.

The chief producers of the tooth brushes are located in Calcutta and Bombay. Two of them are the principal suppliers to the Government, and they quote the lowest indents. They are S. R. Sud & Sons, Moga, Ferozepur, and Aryan Tooth Brush Co., Dadar, Bombay. The price at which they are supplying is only Rs. 8/14 per dozen, and it compares favourably with the price of imported stocks. The prices quoted by some of the other producers are about double, and it is to be seen how far such producers will be able to hold the market after the war. The competition from imports will be great in the post-war period, as before the war.

53. SPORTS GOODS

India was exporting sports goods to other countries before the war. Sialkot in particular and other areas in the Punjab are the production centres for sports goods. With the beginning of the war, these exports have practically ceased, but the indigenous production is still heavy owing to the enormous demands of British, American and Indian Armies stationed in India. There is ample potential capacity for the production of all sorts of sports goods in the Punjab, and after the war, a wide export market can be built up in the Far Eastern countries and Africa, if the industry is worked on a mass production basis, and prices thus brought down.

54. STRAW BOARDS, FIBRE BOARDS, LEATHER BOARDS, ETC.

These boards are required mainly for packing ammunition. Before the war, straw boards worth about three crores of rupees were imported at very low prices. Now a few factories are producing straw boards, chief of them being—

- (1) The Straw Board Manufacturing Co., Ltd., Lahore;
- (2) The Straw Board Company, Meerut;
- (3) The Straw Board Company, Bhopal.

The present Indian production is to the tune of about a crore of rupees and is taken up internally for civil and Defence Services requirements. But the Indian made straw boards are of inferior quality than the imported ones. The supplies made against Defence requirements are given below:—

Article	Quantity supplied	
	1942	1943
Straw boards in tons	41	63
Strawboards—Nos.	15,360	40,450
Straw boards—Sheets	66,000	40,300
Mill boards—various sizes	354,075	275,748
Glazed boards	184,000	176,072

The industry can succeed only on a mass production basis, and it is unlikely that Indian production will expand much after the war, since the main use of these boards is military. Moreover after the war, competition from Britain and America where its production is developed to a very great extent on highly scientific lines, is likely to revive.

55. WATERPROOFING COMPOUND

Before the war, this store was being imported from the U. K. at about Rs. 1,800 per ton. The particular brands used by the Government were 'Pudlo' and 'Matex.' In war-time successful attempts have been made to produce indigenous substitutes of this store by five firms, one each in Calcutta, Aligarh, Lahore, Delhi and Bombay. The brands produced and the rates are different for each producer and the latter ranges from Rs. 1,275 to Rs. 2,560 per ton. The approximate weight of the ingredients is as follows:—

- Coconut oil and lime—55 per cent.
- Caustic soda—15 per cent.
- Ammonium Sulphate—30 per cent.

Of these, coconut oil and lime are available in sufficient quantities, but caustic soda and ammonium sulphate are controlled by the Government in war-time.

The future of the industry is dependent on the cost of production. Since the ingredients are locally available, it cannot be very high as compared to the price of imported brands.

56. ROOFING FELT

The Defence Services demands for this store have all along been met by purchase from the imported stocks within the country. Meanwhile attempts are being made by the following to produce roofing felt with indigenous materials.

- (1) George Henderson & Co., Ltd., Calcutta.
- (2) Universal Asphalt Products & Construction Co., Ltd., Bombay.
- (3) Howrah Mills Co., Ltd., Calcutta.

The samples produced by these firms have been declared satisfactory by the C. I. S. & C., Cawnpore. Sir S. S. Bhatnagar, Director of Scientific and Industrial Research, has also succeeded in making good quality roofing felt.

The chief difficulty in the production of roofing felt indigenously is the scarcity of bitumen in the country. However it has since been able to overcome this handicap as the requisite quality of road tar, medium pitch and hard pitch are now available. The demands for roofing felt are mostly from the railways and are estimated to be about 1½ million square feet. The railways have agreed to accept some of the varieties of the indigenously manufactured roofing felt as war-time substitutes.

Since the industry is in its initial stages, it is too early to predict its post-war prospects.

57. COOKING RANGES

The industry was in existence before the war, but it was in a very initial stage. As much as 85 per cent. of the Government demands were being met by importation. Since the outbreak of the war, the production in the country of cooking ranges has increased substantially and all the

Defence demands are being met by indigenous production. In 1942, 487 and in 1943, 2,141 cooking ranges were supplied to the Defence Services.

There are only a few firms manufacturing this store in the country. Defence Services requirements are being met mostly by Jay Engineering Works, Benares and P. L. Berry & Co., Calcutta, each having a capacity of about 200 cooking ranges a month. The chief raw material required is steel, and if steel of the required quality is available, production can be stepped up to any limit. But as cooking ranges are required solely for military use, the industry may not have any importance after the war.

58. TOMMY COOKERS

These were not being produced in India prior to the war. Their principal use is with the units of field service. They can be made in any quantity, provided steel is available. The production of this article was developed in India in war-time following its introduction in the Army. In 1942, Defence Services required 21,00,000 Tommy cookers of which 3,14,000 were met by local production. In 1943, production increased to 37,35,832. There are about 36 important manufacturing firms of which 34 are located in Delhi and the Punjab. The remaining two are in Calcutta.

In view of the fact that the store is required solely for units going to field service, there will be very small demand after the war, and the same can be met from within the country.

59. SIRENS

Electric sirens are not made in India and have to be imported. But hand operated sirens are being made indigenously in war-time. Nothing is known about the industry before the war. In the early years of war, demand for sirens was not great, but of late, there has been a heavy demand, most of which was met from the surplus stock available with the Civil Defence Department.

This article is not difficult to make and there are quite a good number of manufacturers registered with the Government for its supply, almost all of them being situated in the Punjab. The production capacity can be developed to an appreciable extent, if the steel required for their manufacture is available. But the demand for sirens is not likely to be great after the war.

60. BONE MEAL

The production of bone meal existed in India before the war, and there were no imports of this store from abroad. On the other hand, there was regular export of this store from India to many other countries including other parts of British Empire. The export figures in pre-war and war years are as follows:—

Year	<i>Export figures of bone meal</i>						Quantity in tons
1938-39	25,072
1939-40	47,013
1940-41	34,519

There are about ten important producers, located in different parts of India. After the war the industry is not likely to be injured by competition from abroad, as it already enjoyed in the pre-war days an established position.

61. BADGES, STARS, ETC.

Many small scale units in U. P. and the Punjab are manufacturing small articles such as bar medal ribbon, metal badges, stars, etc., whose principal demand comes from the Defence Services. The industry which was already existing in India before the war expanded considerably as a result of the demand, and now most of the requirements of the Defence Services are being met by the Indian production. The following table shows the figures of supplies made from local production against Defence Services orders.

Demand and Supply Figures of Badges, Stars, etc.

Article	1942		1943		1944	
	Demanded	Supplied	Demanded	Supplied	Demanded	Supplied
Badges	17,66,563	16,58,080	11,31,887	8,86,955	1,38,199	1,98,447
Stars	52,550	40,363	1,36,000	68,000	..	..

In the process of making these articles, there has been some difficulty in embossing etc., but this was made up subsequently. After the war, these particular articles could not be taken up by the civil consumers, but there will continue to be some demand for them from the standing Defence Services. Moreover, the small scale units could then switch on their production equipment to different varieties of trinkets which may be in good demand.

62. HAIR COMBS

This is a cottage industry and its present output is large. The supplies made against Defence requirements are as follows:—

1941	..	..	..	..	..	Nos.
1942	..	..	..	..	..	2,24,400
1943	..	..	..	..	..	24,23,980
1944 (till April)	..	..	..	..	..	15,94,353
						5,40,000

63. POLISHES

Before the war boot polishes were mostly imported. But in war time its production has been taken up by many firms, including Tata Oil Mills, Bombay and the Mysore Government Soap Factory, Bangalore. The chief difficulty in production is the lack of high melting wax in India which is an important ingredient of boot polish.

Various kinds of polishes for metals were being imported before the war. Even after the outbreak of the war, they continued to be imported in very large quantities, especially because the Government requirements for these polishes have been mostly for imported brands. Some indigenous producers have taken up this line, but their output is small.

APPENDIX "A"
POST-WAR ADJUSTMENT OF INDUSTRIES
QUESTIONNAIRE

A. The condition of the industry before the war.

1. **The General position of the industry**, as judged from the capital invested, the number of labourers employed, the proportion of the internal market supplied by the industry, etc.

2. **Lines of production—i.e.**, the different kinds of goods produced and quantities (with values) under each. (Approximate figures may be given if accurate statistics are not available).

3. **Marketing.**—Where each class of goods was sold; for what uses giving percentages, or at least rough proportions, in the case of each.

4. **Centres of production**, and the special reasons, if any, which caused these centres to be preferred (*e.g.*, nearness to raw materials or to market, or to abundant labour supply, etc.). Give the number of factories or units in different centres and indicate the comparative importance of each centre.

5. **Raw materials used:** where they came from.

6. **Processes of manufacture**—nature of machinery and power used.

7. Nature of labour, and conditions of employment.

B. Changes in War-time.

Mention the changes that have taken place in war-time in respect of each item above:

Under item 2, state if any increase in production has taken place? If so, give figures. Is this increase in the same class of goods as formerly produced? Was this secured by working more shifts on the old plant or by adding to the plant and equipment? If the latter, how was this obtained? If the industry has been diverted to new lines of production explain their nature and show how the plant, raw material and technical labour were found. How was the capital obtained?

Under item 3, please state what proportion of the goods went to (i) war orders, (ii) civil consumption and (iii) civil export.

Has the new line of production (or new industry) been pursued in such a way as to be to hold its own in a free market? If not, how may greater efficiency be secured?

C. Post-War Adjustment.

1. What proportion of the output now going into war orders would be suitable for civil markets after the war?

2. What is the likely post-war consumption at home and exportation outside, of each class of goods produced. Estimate on different assumptions (*e.g.*, if certain new lines of demand arises, if they don't arise, etc.).

3. What new lines of production are desirable? To what extent can the existing plant be switched on to the new lines of production? What are the conditions necessary for such a re-adjustment? What new machinery will be required? How much of it can be made at home? How much of it has to be imported? From where?

4. Are any changes desirable in regard to localization? How far can the industry be pursued on small-scale methods in rural areas?

5. Has any special action to be taken regarding adequate supply of raw materials?

6. Can the technical personnel now employed be retained in the industry? If not, what other industries can absorb them? If more technical personnel will be required, how far can they be obtained in India, or trained, within a short period?

7. In the case of ordinary labour, is any serious unemployment likely to arise after the war, and if so, what are the approximate numbers involved?

8. Mention any other relevant points about the industry. If you consider any fresh improvements or new developments desirable, touch on them briefly.

APPENDIX "B"

LIST OF FIRMS*

WOOLLEN MILL INDUSTRY—

1. Cawnpore Woollen Mills, Cawnpore.
2. New Egerton Woollen Mills, Dhariwal.
3. Raymond Woollen Mills, Bombay.
4. Indian Woollen Mills, Bombay.
5. E. D. Sassoon & Co., Bombay (J. S. Mill).
6. Bangalore W. C. & S. Mills, Bangalore.
7. B. K. Subbyah & Sons, Bangalore.
8. Shri Dinesh Mills, Baroda.
9. Oriental Carpet Mfg. (India), Ltd., Amritsar.
10. Ahmed Abdul Karim Bros., Bombay.
11. Usha Woollen Mills, Bombay.
12. E. Sefton & Co., Mirzapur.
13. Shree Karam Singh Woollen Mills, Srinagar.
14. Baijnath Bankey Beharilal Woollen Mills, Cawnpore.
15. The Nagpal Woollen Mills, Bombay.
16. Allahabad Woollen Mills, Allahabad
17. Mahaluxmi Woollen Mills, Bangalore.

LEATHER INDUSTRY†—

1. U.P. Circle—

1. Cooper Allen & Co., Cawnpore.
2. The Cawnpore Tannery Ltd., Cawnpore.
3. The United Provinces Tannery Co., Ltd., Cawnpore
4. The Indian National Tannery, Cawnpore.
5. The Eastern Tanneries, Ltd., Cawnpore.
6. The Hindustan Tanneries, Ltd., Cawnpore
7. W. B. Shewan & Co., Cawnpore.
8. Noronha Model Tannery, Cawnpore.
9. The Ashafaq Tannery, Cawnpore.
10. The Cawnpore International Tannery, Cawnpore.
11. The India Trading Tannery, Cawnpore.
12. The Pioneer Tannery, Cawnpore.
13. The Universal Tannery Co., Cawnpore.
14. The Central Tannery, Cawnpore.
15. The Saghir Tannery, Cawnpore.
16. The Unao Tannery, Unao.
17. The Imperial Tannery, Unao.
18. The Dayalbagh Taj Tanneries, Dayalbagh, Agra.

2. Madras Circle—

1. The Chrome Leather Co., Ltd., Chromepet, Madras.
2. The Gordon Woodroffe Leather Manufacturing Co., Madras, (Pallavaram, Madras).

*It has not been possible to obtain the list of firms in case of all industries.

†Only modern tanneries included in this list. The large number of tanneries which (e.g., in Madras) are engaged in kip tanning are not included in this list.

3. Nazir Hussain & Co., Perambur Barracks, Madras.
4. The Madras Industrial Leather Co., Pallavaram, Madras.
5. The Mysore Chrome Tanning Co., Bangalore.
6. N. Mohd. Mian Rowther, Palakarai, Trichinopoly.

3. Bengal Circle—

1. The National Tannery Co., Ltd., Calcutta.
2. The Calcutta Tanneries Ltd., Calcutta.
3. The Bata Shoe Co., Ltd.; Batanagar.

4. Bombay Circle—

1. The Western India Tanneries Ltd., Bombay.

5. The Punjab Circle—

1. The Bata Shoe Co., Ltd., Batapur.
2. The Punjab National Tannery, Jullundur City.
3. The Jullundur Tannery, Jullundur City.
4. The Punjab Tannery, Wazirabad.
5. The Wazirabad Tannery, Wazirabad.

SULPHURIC ACID—

(Those marked with *are new production established since the begining of the present war.)

Name & Address of the manufacturers		Capacity per quarter (3 months) in Tons expressed as 100% acid
1. Bengal—		
1.	Bengal Chemical & Pharmaceutical Works Ltd., 34, Chitraranjan Avenue, Calcutta	1,950
2.	Belliaghata Acid Chemical Works (Dr. Bose's Laboratory Ltd.) 11, Radhamadhab Dutt's Garden Lane, Belliaghata, Calcutta	330
3.	India Chemical Industries Ltd., 105, Cotton Street, Calcutta	450
4.	The Indian Iron & Steel Co., Ltd., 12, Mission Row, Calcutta	2,000
5.	The Tata Iron & Steel Co., Ltd., 102-A, Clive Street, Calcutta	4,500
6.	Timplate & Co., 4, Bankshall Street, Calcutta	1,050
7.	D. Waldie & Co., Ltd., 8, Clive Street, Calcutta	690
2. North India—		
1.	Cawnpore Chemical Works, Khass (N.W.R.)	90
2.	S.P. Chemical Works, P.O. Jawla Flour Mills, Amritsar (approx.)	100
3.	Shambhu Nath & Sons Ltd., G. T. Road Amritsar	675
4.	Amritsar Chemical Works, Outside Lahore Gate, Amritsar (approx.)	20
5.	Frontier Chemical Works, Rawalpindi	90
6.	Ganga Ram Khushal Das, Sukkur (Sind)	10
*7.	Mining & Chemical Industries Ltd., Jamna Bridge, Agra	115
*8.	Shambhu Nath & Sons Ltd., G.T. Road, Delhi, Shahdara (approx.)	150
*9.	D. M. Chemical Works, Post Box No. 39, Delhi	625
*10.	Ayodhya Prasad Chemical Works, G. T. Road, Ghaziabad, (approx.)	110
*11.	Frontier Chemical Works, Delhi-Shahadra	225
12.	Delhi Acid & Chemical Works, Near Kishanganj, Delhi	120
13.	Cawnpore Chemical Works Anwarganj, Cawnpore	1,600
14.	Krishna & Co., Vidyapith Road, Benares Cantt.	25
3. South India—		
1.	The Mysore Chemicals & Fertilisers Ltd., 112, Vani Vilas Road, Mysore	2,250
2.	The East India Distillers & Sugar Factories Ltd., Managing Agents, Parry & Co., Ltd., First Line Beach, Madras	250
4. Bombay—		
1.	Dharamai Morari Chemical Co., Ltd., Prospects Chambers, 317-21, Hornby Road, Bombay	950
2.	Eastern Chemical Co., Ltd., 15, Dougall Road, Ballard Estate, Bombay	750
3.	Sonawala Co., Ltd., Sonawala Estate, Traders, Bombay	750
4.	Ramoo Chemical Works, Kapasia Bazar, Railwaypura Post Ahmedabad	225
5.	Hira Chemical Works, Goya Gate, Baroda (approx.)	90
6.	Petlad Turkey Red Dye Works, Petlad	100
TOTAL		20,890

The following manufacturers are producing acid for their own consumption :

1. Assam oil Company, Digboi	450 tons quarterly
2. Bararee Coke Co., Calcutta	300 " "
3. Burrakur Coal Co., Ltd., Calcutta	180 " "
4. Rohtas Industries, Dalmianagar	360 " "
5. Adra Fertilizers Ltd., Calcutta	270 " "
6. Cordite Factory, Arvankadu & Kirkee	750 " "
TOTAL	2,310
GRAND TOTAL	23,200 per quarter. 92,800 per annum.

CAUSTIC SODA, BLEACHING POWDER AND CHLORINE—

	Capacity per tons per annum	
1. Alkali Chemical Corporation of India (a subsidiary of I. C. I. Rishra (Bengal)	1,800 (caustic soda). 1,600 (chlorine).	
2. Mettur Chemical & Industrial Corporation, Madras	1,800 (caustic soda). 2,250 (bleaching powder). 300 (chlorine).	
3. Tata Chemicals, Mithapur, Kathiawar	2,000 (electrolytic) 6,000 (causticising) 4,000 (bleaching powder). 100 (chlorine).	} Caustic soda.

DRUGS, MEDICINES & SURGICAL INSTALMENTS—

1. Bengal Chemical and Pharmaceutical Works Ltd., 94, Chittaranjan Avenue, Calcutta.
2. Scientific Indian Glass Co., 6, Church Lane, Calcutta.
3. Standard Pharmaceutical Works, Ltd., Calcutta.
4. Chemical Industrial & Pharmaceutical Laboratories, 289, Bellasis Road, Byculla, Bombay.
5. Alembic Chemical Works, Baroda.
6. Smith Stanistreet & Co., Ltd., Calcutta.
7. Bengal Immunity Co., Ltd., Calcutta.
8. Shambu Nath & Sons, Amritsar.
9. Bengal Water Works, Ltd., Calcutta.
10. Mathur & Mansoor, Ltd., Cawnpore.
11. Calcutta Chemical Co., Ltd., Calcutta.
12. Khandelwal Glass Works, Sasni, Aligarh.
13. Lister Anticeptic & Dressing Co., Ltd., Uma Kanta Sen Lane, Calcutta.
14. Lesco Chemical Works, Bharat Buildings, Lahore.
15. AlcoGas Products, P.B. 74, Lucknow.
16. Kashmir Pharmaceutical Works Ltd., Daya Lodge, Jammu, Tawi.
17. The Government Industrial & Testing Laboratory, Bangalore.
18. Calcutta Industrial Chemical & Mineral Co., Calcutta.
19. Indian Chemical Manufacturers Ltd.; Lahore.
20. W. T. Suren & Co., Bombay.
21. S. P. Chemical Works, Amritsar.
22. New India Glass Works, 7, Rowdon Street, Calcutta.
23. Gurjars Ltd., 12, Temple Road, P.O. Paniahate, Calcutta.
24. F. S. Kerr & Co., 125, Esplanade Road, Bombay.
25. Hind Chemicals Ltd., Grand Trunk Road, Cawnpore.
26. Mysore Iron & Steel Works, Bhadravati, Mysore.
27. Madras Scientific Supply Co., 34, Lingappa St., Madras.
28. Parry & Co., Ltd., Madras.

PAINTS AND VARNISH—**1. Calcutta Circle—**

1. Shalimar Paint Colour & Varnish Co., Ltd., Calcutta.
2. Jenson & Nicholson (India) Ltd., Calcutta.
3. Napier Paint Works, Calcutta.
4. Murarha Paint Works, Calcutta.
5. Hadfields (India), Ltd., Calcutta.
6. Hoyle, Robson & Barnett (India), Ltd., Calcutta.
7. Macfarlane & Co., Ltd., Calcutta.
8. Calcutta Paint Colour & Varnish Works, Calcutta.
9. Solar Paint & Varnish Manufacturing Co., Calcutta.
10. The Standard Paint Works, Ltd.
11. India Paint Colour & Varnish Co., Ltd.
12. Bengal Industrial Co.
13. P. C. Chanda & Co., Ltd.
14. Wilkinson Heywood Clark & Co.
15. Robert Kearsley & Co.
16. Robert Ingham Clark.
17. London Varnish & Enamel Co., Ltd.
18. Lyall Marshall Co.
19. Spence Ltd.
20. Jay Engineering Works.
21. Eastern Paint & Varnish Co.
22. Associated Commercial Concerns, Calcutta.

2. Bombay Centre—

1. Goodlises Wall (India), Ltd., Bombay.
2. Elephant Oil Mills Ltd., Bombay.
3. Hyderabad National Industries (Deccan).
4. Cooper & Co., Bombay.
5. Sun Colour & Paint Manufacturing Works, Jamnagar.
6. Hardcastle Waud & Co., Bombay.
7. Noble Paint & Varnish Co., Bombay.
8. Flintrock Products, Bombay.
9. Asian Oil & Paint Co., Bombay.
10. Bombay Trading Co., Bombay.
11. Bombay Paint & Industrial Works, Bombay.
12. W. H. Deeth & Co., (also Berger's Agents) Bombay.
13. Abdully Sulemanji Rangwala, Bombay.
14. Acme Paint Works.
15. Advance Paints, Ltd.
16. Bassein Paint & Varnish Co.
17. D. D. Shah & Co.
18. New Era Paint Works.
19. National Paint & Industrial Works.
20. Peninsula Varnish & Paint Works.
21. Ratan Singh Rai Singh & Co.
22. Sardar Paint & Oil Works.
23. Simplex Oil & Paint Co.
24. Sardar Paint & Oil Industries.
25. Universal Paint Mfg. Co.
26. Venus Paint Works.
27. Imperial Products.
28. India Clay & Raw Products Supply Co.

3. Karachi Circle—

1. Punjab Paint Colour & Varnish Works, Lahore.
2. Kavi Paint Colour & Varnish Works, Lahore.
3. Crescent Paint Colour & Varnish Works, Lahore.
4. Anglo Dutch Paint Colour & Varnish Works, Lahore.
5. Daurala Chemical Industries, Meerut.
6. H. L. Anand & Co., Kapurthala.

4. Other areas—

1. Hipo Chemical & Pharmaceutical Works, Ghaziabad.
2. Prem Co., Delhi.
3. Jyoti Paint & Varnish Industries, Madras.
4. Cotton Agents Ltd., New Delhi.
5. Bharat Mills, Wazirabad.
6. Arayash & Co., Hyderabad.

GLASSWARE—

1. U. P. Glass Works, Bahjoi (with Seraikella Glass Works, Kandra).
2. Sodepore Glass Works, Calcutta.
3. Ogale Glass Works (Nagpur & Satara).
4. Ganga Glass Works, Balawali.
5. Bombay Glass Works, Badar.
6. Vibhuti Glass Works, Benares.
7. Capital Glass, Ghaziabad.
8. Kaycee Glass Works, Shikohabad.
9. Bhargava Glass Works, Khasa.
10. Khandelwal Glass Works, Sasui.
11. Shree Govind Glass Works, Calcutta.
12. Gurjass Glass Works, Calcutta.
13. Scientific Indian Glass Works, Calcutta (together with Mayurbhanj).
14. New India Glass Works, Calcutta.
15. Paliwal Glass Works, Shikohabad.
16. Allahabad Glass Works, Naini.
17. Upper India Glass Works, Ambala.
18. Naini Glass Works, Bahadurganj, Allahabad.

SOAP—

1. Lever Brothers. (Capacity about 20,000 tons per annum)
2. Tata Oil Mills (Capacity about 15,000 tons per annum).
3. Godrej Soaps.
4. Swastic Oil Mills.
5. The Bombay Soap Factory.
6. The Mysore Government Soap Factory.
7. The Kerala Soap Factory (Madras Government.)
8. The Bengal Chemical & Pharmaceutical Works Ltd
9. Calcutta Soap Works.
10. The Midland Trading Company, Calcutta.
11. The City Soap Works (Dey & Co.).
12. The Calcutta Chemical Company.
13. Jadavpore Soap Works, Calcutta.
14. National Soap Works, Calcutta.
15. Lister Antiseptic & Dressing Company.
16. Golden Soap Factory, Calcutta.
17. Modi Soap Works, Meerut.
18. Modi Soap Works, Meerut.
19. Ganesh Oil & Soap Mills, Cawnpore.
20. The Techno-Chemical Industries, Ltd., Calicut.

PLYWOOD

Name of Factory	Annual Productive Capacity	
1. Plywood Products, Sitapur	2,450,000 sq. ft.	
2. Agricultural Machinery Ltd., Lahore	2,400,000 "	
3. Daurala Sugar works, Daurala U.P.	1,500,000 "	
4. Kundan Lal & Sons, Ludhiana	3,000,000 "	
5. Standard Furniture Co., Kallai	3,000,000 "	
6. Do. do. Chalakudi	3,000,000 "	
7. Malabar Plywood Works, Feroke	3,000,000 "	
8. Kerala Plywood Mfg. Co., Kallai	900,000 "	
9. Jamuna Industrial Works, Dehra Dun	3,000,000 "	
10. Calcutta Plywood Mfg. Co., Calcutta	2,400,000 "	
11. Barat Plywood, Calcutta	1,080,000 "	
12. Standard Wood Works, Calcutta	1,080,000 "	
13. Bengal Plywood Works, Calcutta	540,000 "	
14. Calcutta wood Works, Calcutta	810,000 "	
15. Union Plywood Products, Calcutta (Francis Klein & Co.)	300,000 "	
16. Plywood Industries India Ltd (Holmes Wilson), Calcutta	3,000,000 "	
17. Rohtas Industries, Dalmianagar	1,200,000 "	
18. Indian Forest Industries, Hajipur	3,000,000 "	
19. Mysore Plywood Corporation, Yeshwantpur	12,000,000 "	
20. Travancore Plywood Industries, Punalur	12,000,000 "	
21. Dawn Match Co., Rampur	3,000,000 "	
22. Great Indian Plywood Manufacturing Co., Dum Dum	1,200,000 "	
23. Assam Saw Mills & Timber Co, Murkongselek	13,000,000 "	
24. Assam Rly. & Trading Co., Margherita	}	
25. Karnatak Industrial & Plywood Co., Supa		3,000,000 "
26. Indian Plywood Mfg. Co., Dandeli		12,000,000 "
27. Himalayan Plywood Mills, Siliguri	1,500,000 "	

CUTLERY—

1. Friends & Co., Wazirabad (Punjab).
2. Hakim Rai Jai Chand, Wazirabad (Punjab).
3. Sodeshi Cutlery Works, Nizamabad (Punjab).
4. Punjab Stick & Cutlery Works, Nizamabad (Punjab).
5. Qayum Brothers, Nizamabad.
6. Pioneer Manufacturing Co., Wazirabad.
7. India Works, Nizamabad.
8. Director of Industries, Patna.
9. Premier Cutlery Works, Nizamabad.
10. Northern Manufacturing Co., Wazirabad.
11. Sultan Ahmed & Brothers, Sialkot.

Spoons & Forks—

12. Mohd. Yar Khan, Moradabad.
13. Ganeshilal Jwala Prasad, Moradabad.
14. Ram Kirti Saran Ram Prakash, Moradabad.
15. Damodar Das Radha Kishan, Moradabad.
16. Ram Prakash Sita Ram, Moradabad.
17. Anwar & Co., Moradabad.
18. Haji Kallan & Brothers, Moradabad.
19. Shyam Lal Raghbir Saran, Moradabad.
20. British House, Moradabad.