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by

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PROGRESS OF APPLIED SCIENCE IN ASIA

INTRODUCTION

In this paper the term 'industry' is generally taken to mean an organisation which is engaged in the production of goods and commodities in a factory where the motive power which drives the mechanical equipment is steam, gas, oil or electricity and employing a number of operatives. It may be necessary while reviewing the progress to allude to such aspects as 'agricultural industry' which would mean large-scale farming with modern scientific equipment, with a view to growing food and other crops, like cotton for instance, for the needs of large industries or for the needs of large communities, i.e., beyond what is required by a family or village unit.

Industry in any country should primarily depend on the natural resources such as coal, and oil to supply the power, mineral resources, forest resources etc. Sources of hydro-electric power in a country will have to be taken into consideration.

Since the world has been divided into a number of units, sometimes friendly with each other and at other times hostile with each other, there are certain industries which should be engaged in the manufacture of weapons of offence and defence.

As means of communications like shipping, railways and in these modern days, air travel, improve and expand, it becomes easier for the transport of goods from one country to another to make up each other's deficiencies. At the present time it is an axiomatic fact that no country can hope to exist without the exchange of goods and commodities, and therefore, industries that permit of international trade will have to be taken into consideration. Under the heading 'means of communication' telegraphs, telephones, radio broadcasting and international postal systems and the industries that develop these communications will have to be taken into consideration.

It is usual nowadays to classify newspapers and other journals under the heading 'communications' and therefore, it should be possible to review the progress of the printing and publishing industry in this connection.

Fundamentally and primarily, the object of any country in promoting its industries will be first and foremost to secure the welfare of its people and to cater to the needs of its own people. Then, and then only, surplus commodities available in one country will be exchanged or bartered with goods and commodities of other countries with a view to attaining a balance which will purport to raise the standard of living in every part of the World.

Amongst the primary needs of any country or community should come in the front rank, the fundamental necessities: (1) the adequate provision of the food of the nation so that there will be no starvation, (2) the clothing of the nation, and (3) what is equally important to us, the maintenance of the nation's health free from diseases. These ideals really form the fundamental bases for the formation of any Government and apart from any political theories which hold the ground from time

to time, every system of Government should cater to these needs. In order to attain the maximum success in these directions, it becomes necessary, in modern times i.e., in the latter half of the 20th Century, to make use of all the scientific discoveries, inventions and other benefits of applied science so that with the least amount of human effort or in other words, with the least amount of manual labour, maximum results can be achieved by the application of modern machinery. When the population of the world was small and the various communities of the world lacked communications between and amongst the countries, more primitive economy would have been possible. But it is better to recognise once for all that times are changing and we have to live in modern times. Therefore, each independent country will be vitally concerned with the agricultural industry in order to grow sufficient food for the needs of the population, the textile industry in order to clothe the population adequately and the drug and pharmaceutical industry in order to keep the nation healthy. Concomitant auxiliary industries like the manufacture of artificial fertilisers will come under this category.

Industrial progress made in Asia, can only be gauged and estimated in relation to and comparison with the progress made in Western countries. In this survey, inevitably England takes the first place and a study of the conditions that brought about the so-called Industrial Revolution in England will have to be kept in mind and reviewed. Fundamentally coal and iron, good natural harbours and an ever expanding navy forced England to study the natural sciences and also discover new sources of power (mechanical power) and apply it with a view to minimising manual labour to save time and increase production. The harnessing of water streams and rapids and making use of the water-wheel to supply the mechanical power to a factory, was soon followed by the discovery of steam engines. The greatest and the most important discoveries to begin with related to the textile industries of England and it was not long before the most important and basic heavy industry i.e., the manufacture of iron and steel followed. With a growing colonial expansion all the world over and with an invincible navy and the urge and impetus given by these investigations, England forged ahead. With the initial advantages she had, she also progressed in the field of chemical industries. Electrical industries soon followed.

But the surplus production of England had to be exported to other countries and the British Navy did it. Therefore the products of British factories in the line of consumer goods began to be forced into markets of the World and especially to backward countries like Asia and Africa.

The introduction of telegraphs and railways in India, for example, while they opened the eyes of the Indian population and brought great benefits to the population, also gave opportunities for Indians to get trained in the use of modern mechanical appliances. The same results followed in China and Japan.

STAGES OF DEVELOPMENT

In the development of industries in Asian countries there have been three stages. The first stage is one of forcing a new product or a new commodity or a new mechanical invention on these backward countries. The population was gradually

educated to appreciate the advantages of these new devices and inventions. The second stage followed soon after and this may be called the secondary stage of adoption and assimilation. People of India, for example, during the second stage, wanted to know the why and wherefore of these inventions and took a more intelligent view of the constructional details and could handle the scientific equipment with the necessary technical skill and thereby displace foreign technical operatives who generally came to India with their equipment. Between the second stage and the third stage, there is always an intermediary stage which may be termed as the imitative stage. By this is meant, that in all countries, as familiarity with the handling of scientific equipment and machinery increased, an urge came to copy and imitate the very same mechanical equipment and try to manufacture them in the country, however imperfectly in the early stages, instead of importing them. It would, therefore, appear that when this imitative stage has prolonged sufficiently, we can eliminate the import of these scientific equipment and machinery from abroad and that we can be self-contained. On a close examination, it will be found that this is a fallacious view. It is fallacious because progress in science and applied science depends not merely on the continuance and use of the present knowledge and the multiplication and mass production of articles that result from the application of the present knowledge, but the progress inevitably depends on an uninterrupted flow of new discoveries and new inventions. To any serious student of industrial history, it is obvious that while in countries like Japan, China and India, the imitative stage is progressing fairly rapidly, these countries are finding it to their cost that they are still backward when they take into consideration the more recent scientific advances. Therefore, the object to be aimed at in Asian countries is the third stage viz., an advent of enterprising inventors and purposeful utilisation of their inventions in the country—not merely for the benefit of the country and the inventor but with the object of benefiting other countries as well.

Curiously enough, Japan has passed through all these stages and her transition from the imitative stage to that of invention and inventors has been rapid and phenomenal. This has been due to the political conditions of Japan more than anything else. The wonderful industrial progress in Japan and her emergence from the primitive or mediaeval stage to one of the foremost countries of the world is well-known to everybody. Deservedly (even though with a tinge of humour), the Japanese were termed 'the Yankees of the East'.

What happened in Japan might easily have happened in China and more pertinently in India. In both these countries the second stage, viz., the stage of adoption and assimilation has progressed satisfactorily. That stage is continuing and the imitative stage has also commenced. The final stage of invention and inventors will have to be brought into existence and this could be done only with Governmental support and Governmental action. The third stage requires adequate facilities for research in pure and applied branches of sciences. Also the existence of basic heavy industries like iron and steel, heavy chemicals, development of coal and oil resources and creation of new hydro-electric stations etc., are the prerequisites of further progress. India, no less than China, is alive to this urgent need and she is developing her plans.

At this stage it will be useful to remember one important and unavoidable fact, which is staring us in the face. Further consolidation and progress of even the second stage of industrialisation in Asian countries, except perhaps in Japan, depends on the good-will and friendship of the Western countries, notably USA, and England—to supply the most up-to-date capital goods that we want and also, more important still, to spare expert technologists. If this is not done, there will be an interruption in the development of the second stage of industries and we cannot afford this interruption.

ON PLANS AND PLANNING •

It has been difficult to obtain accurate official information regarding the post war planning of industries in other Asian countries but in India it is well known that plans have been formulated by Government as well as non-official agencies. A notable instance of this planning was the National Planning Committee set up by the Indian National Congress during the early years of the War under the chairmanship of Pandit Jawaharlal Nehru. The work of this Committee was interrupted when the Congress Governments in the Provinces resigned from their office. It is heartening to note that the work of this Committee is being reviewed by a new Board of Development and Planning which has recently been created. In the meanwhile, world-wide attention was focussed on what is known as the 'Bombay Plan' under the signature of seven famous industrialists and commercial magnates of India. This was followed by what is known as 'The Gandhian Plan' and also another one entitled 'People's Plan.' Officially, about the same time the Government of India created a new Department of Planning under Sir Ardeshir Dalal who was himself one of the signatories of the Bombay Plan. This Department of Planning appointed a score of Panels to review the existing state of the main industries in India and make recommendations for the future developments, to begin with during the next five years, and later for a second period of five years. These panels which consisted of available experts in India in their special lines of industries were given all facilities to study and examine the problems facing India and make recommendations for the future, fixing practicable and attainable targets. The work of practically all the Panels has been completed and the new National Planning Board is examining the reports of all these panels. The following group of industries were directed to be examined :

1. Rayon or artificial silk
2. Sugar
3. Cement
4. Paper and Pulp industries
5. Ceramics and refractories
6. Glass
7. Non-ferrous metals
8. Iron and Steel—Major
9. Iron and Steel—Minor
10. Heavy chemical industries
11. Fine chemical industries
12. Electrochemical industries

13. Soap and Oil industries
14. Paints and Varnishes
15. Machine tools
16. Coal
17. Minerals
18. Cotton textiles
19. Silk
20. Electrical industries
21. Plastic industry

DEVELOPMENT IN ASIAN COUNTRIES

The development of industries depending on a thorough and intimate knowledge of applied science has taken place in very few countries in Asia. Of these countries, Siberia which is a part of Soviet Asia may have some industries but we have no information of any kind available in India.

Japan happens to be the most industrialised country, ranking with England, Germany, France and America, but on account of her recent collapse and owing to the difficult situation in which she is now placed, it will not be possible to make any detailed remarks about her industries. Whatever may be the limitations that may have to be placed on Japanese industries in future by the United Nations' Organisation or in the alternative by the Big Four Powers, Japan will very soon come into the picture as an effective participant for the development of industries in Asian countries for purposes of peace, out of sheer necessity to maintain an increasing population (*i.e.* of self-existence).

The next country to be considered is China with her vast population and vast resources. The mineral and forest resources of China are of importance not only to herself but to the whole world. Owing to internal political troubles, China has not been able to forge ahead and industrialise to the extent she deserves. The Chinese are conscious of it and they do not require an outsider to tell them about it. But local factors have been delaying progress and during the last ten years or more, Japanese aggression has added to China's difficulties. But one supreme advantage which China possesses over any other equally important country in Asia, for example India, is that China is independent and has a democratic Government. Further, China has proved to the world that even with her back to the wall she can maintain her independence against foreign aggression. Therefore, when the foreigner has been driven out of the country, it will be easy to settle internal differences and set about building up a new industrial nation, strong and sufficient for all the needs of China. The only industries, *i.e.*, in the sense of producing goods under factory systems, happen to be the textile mills round about Shanghai and other districts, the power-driven filatures in Shanghai and Canton, a number of soap factories of Nanking, and a number of workshops, rice and flour mills distributed throughout the country, and some ordnance factories. China has rich mineral resources like coal and iron which have not been developed fully. Petroleum has been discovered in the Upper Yang-tse-Kiang. China produces large quantities of tin, lead and silver and she has also practically the world monopoly of antimony. Limestone, potters' clay and

other raw materials required for a flourishing ceramic industry are also well-known. China has also a practical monopoly of tung oil but the development of all these industries has been slow and has not been on a scale commensurate with China's size and population, even though one may find a fair development of rural industries. The Indusco movement of China has envisaged the starting of a number of industries adopting the factory system but run on co-operative principles. If this movement which since its inception has shown great vigour and great potentialities should receive further impetus and support both from the Government and the people, it is bound to speed up industrial progress of China.

There are other Asian countries to be considered before we finally take up the position of India. We have not much information about Turkey. Hints have been given in various political and commercial journals that the Ankara Government is determined to industrialise Turkey to the maximum extent possible. Electric power and mineral development schemes have been hinted at. Ordnance factories are supposed to be working under the guidance of British and American experts; it was reported that German experts were also co-operating with the Turkish Government. But there is no reliable data or statistics from official sources. Therefore, it is difficult to say anything more.

In countries like Syria, Palestine, Arabia, history tells us that there is no great urge to industrialise these countries not only on account of the life and habits of its people but also because of the political condition of these areas. Hopes have been entertained that Palestine may, to some extent, industrialise herself and utilise her natural resources. But it is yet to be.

Iran occupies a peculiar position. The only industry of any importance is the petroleum industry and this, as the world knows, is being worked in British interests and under British control. Further development of the petroleum industry in Iran has recently been the subject of notice and comment in the world press. Rivalries have been hinted between and amongst Russia, England and the United States of America. But for the purpose of this special article, the one observation to be made is that the only worthwhile industry is the petroleum industry and it is entirely in British hands.

Even though Afghanistan is a neighbour and her foreign trade passes through the port of Karachi, very little is known about her industrial progress. It has been hinted that geological surveys are under progress and some new industries have been projected.

Coming to South-East Asia, we are confronted with the rich Dutch Empire with all its numerous and varied resources, agricultural, forest and mineral. Statements have been made that nobody has yet been able to catalogue and estimate completely the wealth of this empire. Some industries, agricultural and industrial, have come into existence and the Dutch people and the Dutch Government have been the beneficiaries of these developments. The most up-to-date methods are employed in Java for the production of rice, coffee, tobacco and cinchona. In fact, for this anti-malarial drug, Java holds a virtual monopoly even though recent attempts

for synthetic quinine have been successful, and even substitutes have been discovered. Java also produces a fair amount of rubber. The petroleum industry of Java is very well known and is of tremendous importance in the Southern Pacific. Sulphur is an important mineral which is mined and exported to other countries. Palm oil and tea have definitely claimed an important place in the international trade. Teak and other valuable timbers are staple products of export from the Dutch East Indies. In spite of these remarks, what is specially to be noted, is that the development of these natural resources has taken place with the main idea of benefiting Holland and the Dutch nation. They have been planned in imperial interests and the people of Indonesia have not been technically trained, in the higher sense of the word, to develop the natural resources in national interests. Indonesia is on the eve of independence and with the initial start she has been able to command, albeit through the agency of Dutch imperial interests, she is bound to play an increasingly important part in the development of industries in Asian countries. This review of progress in Indonesia would have been fuller had official statistical information been available.

What about the Philippines? The United States Government as a colonial power has set an example to the world and other Imperial Governments in granting independence to the Philippines. During the time that the Philippines were directly under Washington certain developments have taken place which fair-minded Americans admit were in the interests of American Commerce and Industry. But at the present time, there are no obstacles placed in the way of the Philippine Government to develop her industries in any manner she pleases and what is refreshingly agreeable and welcome is the attitude of America in agreeing to help the Philippines in whatever way she pleases by rendering assistance in the form of capital goods and loan of technical experts. Under this benevolent treatment from USA, it should be no wonder if the people of the Philippines lean more and more towards American habits of thinking and American modes of industrialisation and American ideals of democracy in relation to other parts of the world. And the other countries of Asia should wish the Philippines well and offer their best wishes for speedy and purposeful industrialisation of their islands. While satisfying the requirements of USA, there will still be ample room for co-operation with other Asian countries and the Philippines will play a notable part in the future development of the Southern Pacific. In international trade the Philippines take a prominent part in cocoanut oil.

We have yet to consider Burma and Malaya. From the point of view of international trade the only products coming into the picture are Burmese timber, Burmese rice and Burmese petroleum. Burma also has resources of tin, lead and zinc and some other strategic minerals that are deficient in India. Some minor industries have been conducted in Burma on factory principles, but considered as a whole, they are yet in their infancy. That Burma was exploited even when she was a part and parcel of India in the interests of Great Britain and Ireland is known too well in the world. Burma has now been separated from India and it is very heartening to see that she is standing up for her own independence. When this happens, it is hoped that Burma will be a good neighbour to India and other countries and her great resources will be developed to advance Burmese interests and also to co-operate with other Asian countries.

It is convenient when considering Malaya to include Ceylon also. The development in these countries, whether agricultural or industrial, has taken place on the pattern set by the Colonial Office in London. The British vested interests hold the field in every branch of life's activities. British planters, British commercial firms and the all-too British manned Government have been enjoying the riches of these colonial possessions and it will be tiresome to relate their story in this brief article. It is impossible for other Asian countries not to be interested in these people but it will be sometime before these British possessions will develop industrially in the near future, except in the interests of British. The tin mining industry in Malaya is of world-wide importance. Ceylon has the best graphite in the world. Ceylon tea is world-famous.

Siam, Cambodia and Indo-China will have to be next considered. Industrially, Siam has been a negligible factor. The same remarks apply to the French possessions viz., Cambodia and Annam. Any minor developments in the industrial field that have taken place in these French possessions are of a minor character. These colonies have been exploited for the benefit of France. Reliable information is lacking about these Asian countries and what their future will be is difficult to forecast. Rumbblings of popular movements for independence are reaching India through the international press, but what part these countries will play in the future of industrial development in Asia is still obscure.

DEVELOPMENT IN INDIA

General

The development and progress of applied science in India will have to claim our attention at this stage. A reference has already been made in the previous paragraphs about the schemes of post-war planning. The long list of industries that require reorganisation and further expansion gives us an idea as to the range and variety of big and small industries that exist and flourish in India. If Japan does not come into the picture, India happens to be the foremost industrial country in Asia. This development has taken place during the last 100 years under a foreign government. Even though the development of the economic resources of India was undoubtedly in the interests of England, we need not deny that India in this process has derived great benefits. A great many of these happen to be of a permanent and basic character. In the absence of a dominant foreign power India might have done better, probably. India may not have progressed as much, opponents may retort. At the end of this controversy, it is to be conceded that something is left behind, something that can be salvaged which is of a permanent nature. In the early stages, the introduction of railways and telegraphs, the development of an All-India Postal system, the construction of strategic roads all over the country, the civil engineering works like river-dams with irrigation channels radiating in all directions, the construction of bridges, tunnels, etc., and a host of auxiliary services necessary to achieve these results gave a great opportunity to Indians to come in contact with the then recent discoveries and inventions for the benefit of the community. India had always been ranked as well advanced in the civil branch of the engineering industry but the contact with English engineers and also the opportunity of handling large scale and important projects infused new blood, as it were, into the Indian engineers.

So much so, that today so far as civil engineering is concerned, India can hold up her head on terms of equality with any other nation of the world. The construction of a huge reservoir across the river Cauvery at Krishnarajasagar in Mysore may be cited as an example where, from the inception of the idea right up to the final stage of construction and completion of the dam, only locally available constructional materials, locally manufactured *surki* mortar, one hundred per cent local labour were employed under the direction of a team of first-rate civil engineers with Sir M. Visvesvaraya as their leader. There are other similar projects that can be cited. Such projects which supply hydroelectric power and at the same time supply water for irrigation purposes are coming into existence all over India and they occupy the foremost place in post-war planning in India.

Minerals

As in every other country industries in India will have to depend primarily on the natural resources of the country: mineral wealth, forest wealth and agricultural wealth. A brief survey under these three heads will be attempted.

India produces approximately 30 million tons of coal. Even though this may be considered a fairly large quantity, it falls short of the present needs of the Indian railways and industries. Unfortunately, during the past, a very large quantity of coal specially suited for the manufacture of metallurgical coke was employed wastefully on railways. A special Committee appointed by the Government of India have recently made recommendations to conserve the special grades of coal which yield metallurgical coke. At the same time they have made comprehensive proposals for the utilisation of other grades, to step up the production and to avoid the present wasteful methods of mining, and, finally, to improve the condition of mining labour.

It is only in the north-west and the north-east of India, that the petroleum industry is making a beginning. As compared with the petroleum resources of other countries like USA, Venezeula, Russia, Rumania, Iran, the East Indies and Burma, the Indian production is small. But arrangements have been made for further surveys and it is hoped that new sources of oil will be discovered.

Regarding the general condition of the mineral wealth of India, the following remarks by Dr. D. N. Wadia, Mineral Adviser to the Government of India state the present position briefly and accurately :

'The mineral resources of India, are not, for a country of its size and its population of enormous proportions as is at times confidently declared. Except in minerals such as iron ore, aluminium ore, and possibly mica, manganese, magnesite, thorium and titanium of which exportable surpluses are large and of world importance, the deposits are of decidedly limited extent and call for a policy of strict conservation and planning in the interests of the future national needs. The discovery of new mineral deposits of wide extent and richness by the old time methods of surface prospecting does not appear probable. But the new methods which have come to vogue—electrical, magnetic and seismo-metric prospecting—seem to offer possibilities. By these means deposits of petroleum, a few more new coal fields, ore bodies, large underground water deposits have chances of being brought into life.

'The mineral resources of India though limited, are however by no means inconsiderable and encompass sufficient range of products necessary to make a modern civilised country, within feasible limits, industrially self-contained. Minerals of strategic and defence importance can be regarded as adequate although in parts only; there is a serious deficiency in munition metals like tungsten, tin, antimony, lead, zinc, mercury and also in graphite and liquid fuels. But in the basic metals, iron, manganese, aluminium, magnesium and chromium, the country is well supplied, in the first three, in large excess. To a considerable extent our deficiency in munition metals is made good by adequate stocks in Burma which still has oil resources of considerable magnitude. Ceylon has resources of the world's finest graphite, a mineral indispensable in metallurgy.'

The iron and steel industry in India has been well developed and the future plans envisage not only national self-sufficiency but also an exportable surplus. It has been stated that the Tata Iron and Steel Works happen to be the largest of its kind in the British Empire. It should, however, be admitted that India has not progressed in the manufacture of special alloy steels which play such an important part in the fabrication of modern industrial machinery and also in the manufacture of not only ships, submarines and aeroplanes but also of every type of military weapons of offence and defence. Nonetheless there has been a fair development of the following industries which depend on a central iron and steel industry: manufacture of rails, angles, sections, rods and bars, tin plates, bolts, nuts and rivets, steel castings, wire and wire products, pipes, machine tools, other varieties of small tools and implements, water pumps, oil engines, water fittings, pulley blocks, miscellaneous types of ordinary machinery, road making equipment, manufacture of railway wagons, petrol cans, oil containers, food cans, hurricane lanterns and all types of steel furniture, office fittings etc. Except for cataloguing them, it is impossible to review in any detail their development in India. India is also very backward in the manufacture of capital equipment required in our factories like textile mills, oil mills, chemical factories, iron and steel works, cement factories, sugar mills etc. Manufacture of locomotives and ship building has been talked about for over quarter of a century but nothing substantial has been achieved in this direction. India is, however, determined, cost what it may, to alter the present deplorable position. The same remarks apply to the manufacture of such an ordinary things, as the humble bicycle and its consequential development, the manufacture of motor cars. Plans have been developed to make good these deficiencies. In the fields of manufacture of aeroplanes, only one initial attempt has been made by the Government of Mysore, and the Hindusthan Aircraft Ltd., Bangalore, even in its infant stage, did yeoman service during the last War. Further development of the aircraft industry has been kept in mind by the Government of India and also the foremost industrialists of the country.

Recently some companies have been started to manufacture electric motors, transformers, switch gear, storage batteries, radio sets, machine tools, oil and gas engines etc., generally with foreign help and co-operation, technically and financially.

Other industries that depend on the mineral wealth of the country have been fairly well developed. Foremost of these is the manufacture of cement. The

present production capacity of cement in India is far in excess of the present demands and India is well placed and provided in this field. Glass, ceramic, pottery, roofing and flooring tiles, refractories, etc., depend on the locally existing minerals and the future of these industries is hopeful and promising. Mention may be made of occurrence of huge deposits of gypsum in India and large quantities of it will be used in the new fertiliser factory under construction at Shindhri and sponsored and owned by the Government of India. Special mention should be made of one other source of what is, perhaps, today the most important mineral in the world. The monozite sands of Travancore give a unique place of importance to India, and the Government of Travancore and the Government of India are very much alive to all the implications of this wealth in the country. It is unnecessary to say anything more regarding the ramifications of this rare-earth industry.

A mineral which is important as a food material and also as an industrial raw material is, rock salt (sodium chloride). About 35% to 40% of India's requirements are met with by this. The balance is made good by sea salt, which is obtained by solar evaporation of sea water. Both methods of obtaining this basic material are important industries in India.

An important mineral in which India holds a virtual monopoly is mica. The Government of India is greatly concerned about this mineral asset of world-wide importance and have prepared schemes for the rationalisation of this industry.

Prominent mention should be made of Mysore since practically all the gold mined in India comes from this State. It should, however, be admitted that this industry is in the hands of a very powerful British firm.

It is relevant to mention that recently the Government of India convened an all India Conference consisting of the representatives of British Indian Provinces and Indian States to lay down a general mineral policy for the whole of India with a view to conserving the mineral resources of the country primarily for the benefit of India, and whenever there are exportable surpluses to barter them with other nations of the world for materials and commodities in which India is deficient. Avoidance of wasteful methods of mining, amelioration of the conditions of mining labour, the establishment of a Central Bureau of Mines and Minerals with a view to introducing standard methods of mining, assaying and valuation of minerals found in India and also to have a Central Bureau of Statistics and Information and, more important than all, to arrange for a comprehensive and exhaustive survey of the mineral wealth of the country by the latest geophysical and seismographic and electrical method these aims are kept in view in the post war reconstruction.

Forests

Industries that depend on forest wealth are fairly well advanced. There was a time when Indian forests were considered as simply sources of valuable timber for building purposes in the country and for exports to foreign countries not only as a constructional material of residential buildings, and offices but also to supply timber for ship-building. Other valuable raw materials like drugs, herbs, tanning materials

etc., used to be exported also. The Indian forests provided also domestic fuel. But recently, as a result of the researches conducted at the Forest Research Institute at Dehra Dun, some new industries have come into existence and have established themselves. Foremost amongst these is the paper-pulp and paper industry in India mainly depending on the bamboos found in Indian forests and also to a limited extent on forest grasses. The manufacture of mechanical wood pulp for newsprint from Andaman woods has been taken up. Cellulose from wood-pulp or bamboo-pulp will form the raw material for viscose rayon and acetate silk. Special woods from Indian and Andaman forests are used in the manufacture of safety matches. Excellent furniture is made out of Indian woods. Plywood industry has also received a big impetus and we have reasons to believe that India will be self-contained in this respect very soon. The manufacture of rosin and turpentine in the Punjab from the pine trees in Northern India is a well-established forest industry and India, at the present time is more or less self-contained. The only wood distillation plant in Asia, happens to be in the State of Mysore at Bhadravati, where the latest methods of carbonisation of wood are conducted and all the bye-products are recovered and processed to yield standard products. Amongst these, methyl alcohol and acetic acid will have to be mentioned prominently. At the present time, Bhadravati is the only source of methyl alcohol in India. *Nux Vomica* seeds from Orissa forests are utilised for the manufacture of strychnine in Calcutta by a well-known British firm. A number of tanning materials, oil seeds, etc., from Indian forests are exploited and utilised in different parts of the country. Kashmir is notably rich in natural drugs.

Two other items of forest wealth of great national importance need be mentioned. India holds a virtual monopoly in both these products. Shellac is the first product and sandalwood is the second product. Bengal, Bihar, parts of Orissa and C. P. and a number of Central Indian States supply the whole world with shellac. The State of Mysore controls 7/8 of the world production of sandalwood and has the biggest and most up-to-date sandalwood oil factory in the world in the City of Mysore.

Agricultural Industries

Many of the industries depend on agricultural operations. Mention need only be made of the following: cotton, sugarcane, tobacco, oil seeds and jute. The last mentioned agricultural product has placed India in a very strong and unique position in the World and Indian jute is a powerful aid for bartering purposes in international trade. The development of the Indian cotton textile industry, the recent expansion of the sugarcane industry which makes India almost self-sufficient, the starting of new factories for the manufacture of cigarettes, cigars and other tobacco products all over India are instances of utilisation of agricultural raw materials in modern factories in a rational way for the benefit of the country. To aid agriculture for increasing the yield per acre of the suitable crops and also to improve the quality of the products, the Government of India have decided to start a huge fertiliser factory with a projected capacity of 350,000 tons of ammonium sulphate per annum. Another important industry that depends on agriculture is the oil industry with all its ramifications. Oils and fats play an important part in the nutrition of the population of a country but they form

the basis of important industries like the manufacture of soap, the manufacture of hydrogenated oils like *ghee* and butter substitutes, the manufacture of paints and varnishes, the manufacture of lubricating oils and greases etc., etc. India is well placed regarding the development of these industries and future plans provide for the growing needs of the country. Purely from a national point of view the aim kept in view is, instead of exporting the oil seeds from India, to export oil and keep back oil cake as a feeding material for cattle stock and also as an organic manure. India happens to be one of the biggest producers of oil seeds in the world and export of oil seeds forms a major section of the foreign trade of India. In fact, as in the case of jute, India is placed in a better bartering position through her oil seeds.

Hides and Skins

There is another important commodity in which India plays a dominant part in the international trade. It is not easy to classify this under the heading, mineral, forest or agricultural wealth. It will have to be classified by itself. It refers to the Indian hides and skins. The extent to which the leather industry in England and other places on the continent of Europe depends on the import of Indian hides and skins is well-known. Instead of exporting the raw materials, there have been suggestions during the last 30 years to manufacture the various varieties of leather goods required by different parts of the world but the progress in this direction has been slow and it is 'boot-less' to look into past failures. Industrialists all over India are alive to this problem and the manufacture of leather goods on a factory scale is on the increase all over India and it will not be a vain hope to expect a brighter and more prosperous future.

A concomitant of this industry is the availability and the utilisation of bones as a source of phosphorus for Indian crops. This will be referred to in dealing with chemical industries.

Silk

As compared with China and Japan the production of silk and silk goods is small in India. During the last war India happened to be the only country in the British Empire (nay, on the side of the Allies since Chinese supplies were cut off) that could supply silk for parachutes. Mysore supplied more than half the Indian silk, followed by Kashmere and Bengal.

Sheep farming is widely distributed all over India and large quantities of wool are available. But the quality, except in some places in Northern India is not of a very high standard. The manufacture of rugs, blankets, carpets and druggets, and the famous Kashmere shawls is a widely distributed and well established industry in India.

Chemical Industries

We have next to consider the development of chemical industries in India. It is conventional to classify chemical industries under two headings, heavy chemical industries and fine chemical industries. India has made a beginning in both the fields, but the progress has not been satisfactory. The basic sulphuric acid industry has been handicapped by lack of sulphur deposits in India and it is only recently

that decisions have been taken to use the naturally occurring sulphur-bearing mineral, gypsum, to take the place of sulphuric acid in the manufacture of ammonium sulphate at Sindhri. The output of caustic soda, sodium carbonate, sodium bicarbonate is far short of the demand. All the industries that require these chemicals will have to depend on imports and at the present time practically the only source is from England and a virtual monopoly in this field is enjoyed by a single British firm. Fair progress has been made in the manufacture of ferrous sulphate, magnesium sulphate, copper sulphate, aluminium sulphate, alums, potassium dichromate, calcium chloride, etc. Schemes have been worked out to make sodium sulphite, sodium sulphate, sodium thiosulphate, sodium sulphide, sodium hydrosulphite, barium chloride etc., which are required in large quantities in India and which are now imported. There is a very big deficiency in the production of super-phosphates and also ammonium sulphate, both forming the most important chemical fertilisers. India used to export large quantities of bones from which superphosphates can be manufactured and all the Provincial Governments and Indian States are taking steps to conserve this important raw material in the country. But to satisfy fully the needs of India for superphosphates, we have to import rock phosphate from North Africa or one of the Southern Pacific islands since the locally available Trichy deposits are very poor in quality. As mentioned earlier a huge plant for the manufacture of 350,000 tons of ammonium sulphate has reached the construction stage at Sindhri. The manufacture of viscose rayon and acetate silk is an important chemical industry which flourishes in USA, Japan, England, Germany, France and Italy. Several new companies have been floated to start this industry in India with foreign help and co-operation. Negotiations are going on to start a joint Indo-British concern to manufacture dyes, and another firm to manufacture synthetic plastics. All these industries require abundant and cheap supplies of heavy chemicals. A great headway will have to be made before India can become self-contained in the field of heavy chemicals and the Panel which considered this question has made constructive and valuable suggestions. Before these schemes fructify capital goods from abroad as well as help of technological experts from abroad will be necessary.

In the field of fine chemicals and pharmaceuticals, India has made greater progress and there has been a spurt of great activity in this field all over India judging by the number of new companies that have been floated during the last dozen years. But it is an axiomatic fact that the fine chemical industry presupposes the existence of a flourishing heavy chemical industry and also the supply of cheap solvents like alcohol, benzene etc., and an abundant supply of water, cheap fuel and also mechanical equipment of a fairly specialised character. The pharmaceutical aims at the utilisation of the forest resources like vegetable herbs and drugs and also some naturally occurring minerals. Synthetic drugs are displacing the natural products all the world over and India will have to be alive to the recent advances in chemo-therapy and also the astounding advances and discoveries in the field of bio-chemical preparations.

Electrochemical Industries

Another branch of industries that are destined to play an important part in India may be classified as electrochemical industries. The most outstanding example in this field is the manufacture of aluminium from the locally available bauxite in two

or three different parts of India. The present factories will not be able to supply the entire needs of the country and two other fairly large factories have been projected. Small units of electric furnaces have been installed for the manufacture of alloy steels, the most notable instance in this field being the ferro-silicon furnaces at Mysore—the first of their kind in India. The Mysore Iron and Steel Works have placed orders for a fairly big range of electric furnaces for the manufacture of pig iron and steel and also other ferro-alloys like ferrochrome, ferrosilicon etc. Electrolytic alkali plants for the manufacture of caustic soda and chlorine have been established in Calcutta, Mithapur (Gujerat) and Mettur (South India). There are a dozen new projects distributed all over India for the installation of more electrolytic alkali plants. In recent years, there has been a tremendous expansion of the vegetable *ghee* industry in India and most of these plants obtain hydrogen by the electrolytic decomposition of water. In the first synthetic ammonia plant in India installed at Mysore, hydrogen is obtained by a big electrolytic unit, consuming nearly 3,500 KW.

The development and prosperity of electrochemical industries in India—as anywhere else in the world—will depend on the supply of cheap electric power. Unless the country is very well placed regarding cheap coal and an abundant supply of water, production of electricity in thermal stations will be more costly than by what is popularly known as hydro-electric development. In this field also the State of Mysore was the first in India to instal a hydro-electric station at Sivasamudram, Mysore State, at the beginning of this century, and other developments followed soon all over India, the most notable instance being the Tata enterprises in Bombay Presidency. India is alive to the importance of the hydro-electric development, not only for starting electrochemical industries, but as a source of motive power in all industries. The resources of coal and liquid fuel in India are limited and the existing coal fields are concentrated in North India. Therefore, we have no choice except to depend on the fullest utilisation of hydroelectric power all over India which has also another important bearing on the internal agricultural economy in that plentiful supplies of water will be available for irrigation purposes. Provincial Governments and those of Indian States have all launched big developments in this field and the Central Government is sponsoring and financing three huge schemes in connection with the control of floods and the avoidance of erosion associated with the rivers, Damodar, Kosi and Mahanadi.

Synthetics

In this paper it has been tacitly assumed that we have to depend on the natural resources of the country. But the trend of events in other countries actually is to synthesise new products to replace and displace the naturally occurring commodities. A mere mention of the following synthetic products will show the astounding progress already made: synthetic petrol, synthetic oils, fats and waxes, synthetic rubber, synthetic sugar, synthetic tanning materials (the so-called syntans), synthetic ammonia, synthetic fibres like Nylon and Vinyon, synthetic indigo and synthetic quinine—the list can be added to. All these synthetic products are of vital importance in the life and welfare of humanity, and India is very backward in this field. We are still at the stage of gasping with wonder at these achievements of modern science and it will be long before we can find a place among other advanced nations. Advances in other fields of human activity like radio, broadcasting, the perfection of Radar,

the utilisation of atomic energy, the wonderful advances in military weapons, of offence and defence, the new wonder drugs like Penicillin, DDT, Gammexane, Mepacrine, Paludrine, etc., have been achieved in other countries because they realise the importance of fundamental scientific research and provide adequately for the continuance of scientific research on an ever increasing scale.

Fundamental Research

Whatever might have been the political and other causes which left India far, far behind other more advanced nations, it will have to be acknowledged that India is finding it hard at the present time to keep in touch with the latest achievements of science and technology in countries like Germany, England, Soviet Russia and USA. We are still absorbing scientific information and acquiring technical knowledge to the extent these nations are releasing it and making it available to us. We have been like sponges absorbing all we can from Western countries. We have yet to pay our debts to humanity in contributing to the pool of scientific knowledge, not necessarily for war purposes but fundamentally to enhance the wealth and welfare of humanity. A beginning has been made in the fields of fundamental research and India has started making her own contributions. The distinguished names of 7 Fellows of the Royal Society of London are household words in all the schools, colleges and factories of India. But this is only a beginning. Fundamental research cannot flourish unless by generous grants from all the Provincial and State Governments and also for certain special purposes from Central funds. In Western countries, such contributions from the Government treasury happen to be small compared with the huge amounts spent for research by industrial corporations. Irrespective of party loyalties, our political leaders have today realised the importance of this need for scientific research in India and funds have been provided for the starting of a National Chemical Laboratory, a National Physical Laboratory, the National Metallurgical Laboratory, research institutes for the study of fuels, glass etc., etc. It is hard to resist the temptation of mentioning one illustrious commercial concern in India,—to wit the house of Tatas—which has been making generous and frequent grants for scientific research in India. It is hoped that the other big commercial and manufacturing concerns in India will follow this example.

Labour

Even though it does not fall within the strict limitations of this paper one other aspect should be mentioned and it is a fundamental aspect in the field of development of industries in India. Except, perhaps, China, India is among the few countries which today possess a fairly easily satisfied and contented labour force with various aptitudes, capacities and competence. It is no doubt true that even in India we are hearing of strikes, lock-outs, labour disturbances, etc. On the whole as compared with countries like England and America, India is still in a better position and in future planning of industries in India, it should be our endeavour to keep this labour contented.

Finale

It is impossible in India, today, to think of any kind of National Development in any field of life's activities without coming to Mahatma Gandhi. The Mahatma's

chiding and admonishing finger is pointed at me and I feel it. Even though I am convinced that the industrial development as briefly surveyed in the foregoing notes is inevitable and must be put through at all costs in India, the problem of providing a congenial and suitable occupation to the teeming millions of India will still stare us in the face. If we should keep our place in the race for industrial development, we shall have to use huge economic units and employ, whether we like it or not, labour saving machinery etc. We can produce all the food that India requires by the application of synthetic manures, we can produce all the cloth that our 400 million people require in our modern textile mills, supplemented wherever possible by hand-looms, we can be fairly well provided with weapons of offence and defence, we can develop our pharmaceutical industries to keep the Indian nation healthy and strong,— we will have achieved all these things, say within the next 25 years. But have we provided an occupation for our people? Will not the people of the country, as a whole, deteriorate if they are simply well-fed and clothed and kept healthy and not provided with something to do? Can we evolve from a lower state of existence to a higher state of existence in the absence of suitable occupation and in the absence of efforts in every field of life's activity to do something and to strive after something better so that we might fulfil the purpose of God? Only the Mahatma can show us the way.