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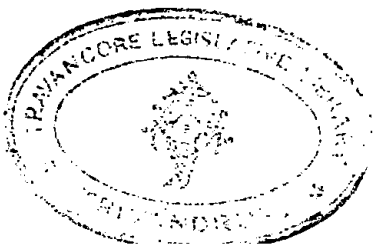

MINING AND METALLURGY

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NATIONAL PLANNING, PRINCIPLES & ADMINISTRATION

K. T. Shah.

NATIONAL PLANNING COMMITTEE SERIES

(Report of the Sub-Committee)

MINING AND METALLURGY

Chairman

DR. D. N. WADIA

Secretary

DR. V. S. DUBEY

Edited by

K. T. Shah

Honorary General Secretary

NATIONAL PLANNING COMMITTEE

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To

All Those

MEMBERS OF THE NATIONAL PLANNING COMMITTEE

and of

Its Various Sub-Committees

A TRIBUTE OF APPRECIATION

प्रारब्धमुत्तमजना न परित्यजन्ति

PERSONNEL OF THE SUB-COMMITTEE ON MINING AND METALLURGY

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(*Delegate of the Labour Sub-Committee*)

Dr. B. R. Seth

PREFACE

The National Planning Committee, appointed in 1938, began its work early in 1939. After defining the nature of a National Plan, and determining the nature and scope of the work entrusted to them, the Committee issued an elaborate and comprehensive Questionnaire which was subsequently supplemented by specific details. Twenty-nine Sub-Committees, formed into eight groups, were set up with special terms of reference to deal with all parts and aspects of the national life and work in accordance with a predetermined Plan.

After some unavoidable delay in getting replies to the Questionnaire, the Sub-Committees began their work, and submitted Reports,—some of them Final, some Interim,—which were considered at the Plenary Sessions of the Parent Committee in 1940. Towards the end of that year the Chairman, Pandit Jawaharlal Nehru, was arrested and sentenced to a long term of imprisonment, during which the work of the Committee had necessarily to be suspended.

On his release a year later, hope revived for an intensive resumption of the Committee's work. But the outbreak of war with Japan, the threat to India's own safety, and the hectic march of political events, rendered it impossible to devote any attention to such work at that time. It, therefore, inevitably went into cold storage once again; and remained for the duration of the war.

When at last the War seemed nearing its end, Pandit Jawaharlal Nehru with other leaders was released. The moment seemed again opportune to resume the work of

the Planning Committee. Meetings of that Body were held in September and November 1945, when certain more urgent questions, already included in the programme of the National Planning Committee, were given a special precedence. A Priority Committee was appointed to report upon them. Changes and developments occurring during the War had also to be taken into account; and another Committee was appointed to review the general instructions, given six years earlier to the Sub-Committees. Revised instructions were issued to them following the Report of this Sub-Committee; and the Chairmen and Secretaries of the several Sub-Committees were once again requested to revise and bring up to date such of the Reports as had already been submitted—either as final or interim—while those that had not submitted any reports at all were asked to do so at an early date.

As a result, many of the Sub-Committees which had not reported, or had made only an Interim Report, put in their Reports, or finalised them. The Parent Committee has had no chance to review them, and pass resolutions on the same. But the documents are, by themselves, of sufficient value, prepared as they are by experts in each case, to be included in this Series.

The following Table shows the condition of the Sub-Committees' work, and the stage to which the Planning Committee had reached in connection with them.

Serial No.	Name of the Sub-Committee.	Final Report		Interim Report		No Reports
		N.P.C. Resolutions	Not considered by N.P.C.	N. P. C. Resolution	Not considered by the N.P.C.	
Group I.	**Agriculture & other Sources of Primary Production**	Handbook Pp.		Handbook Pp.		
1.	Rural Marketing and Finance	97-99				
2.	River Training and Irrigation Part I	83-85				
	,, ,, ,, Part II	113-115				
3.	Soil Conservation and Afforestation	115-119				
4.	Land Policy and Agriculture			139-141		
5.	Animal Husbandry and Dairying	87-89				
6.	Crop Planning and Production				do.	do.
7.	Horticulture	102-103				
8.	Fisheries					
Group II	**Industries or Secondary Sources of Production**					
1.	Rural and Cottage Industries					
2.	Power and Fuel		do.			do.
3.	Chemicals					
4.	Mining and Metallurgy			77-79		
5.	Engineering Industries	75-77		130-133		
6.	Manufacturing Industries		do.			
7.	Industries connected with Scientific Instruments		do.			
Group III	**Human Factor**					
1.	Labour	89-92				
2.	Population	85-87				
Group IV	**Exchange and Finance**					
1.	Trade					
2.	Public Finance					
3.	Currency and Banking			122-126		
4.	Insurance			93-95		
Group V	**Public Utilities**			95-97		
1.	Transport					
2.	Communications	126-129		120-122		
Group VI	**Social Services—Health and Housing**					
1.	National Housing					
Group VII	**Education**					
1.	General Education			133-139		
2.	Technical Education				do.	
Group VIII	**Woman's Role in Planned Economy**					

To sum up, fourteen Sub-Committees had made final reports, of which ten have been considered, and Resolutions taken upon them, by the National Planning Committee. Twelve more have presented Interim Reports, of which nine have been considered by the Planning Committee, with Resolutions thereon, while three Sub-Committees have not yet presented any report on the reference made to them.

The idea that all this material, gathered together with the help of some of the best brains in India in the several departments of our national life, should be printed and published was before the Committee from the start. But the interruption caused by the war prevented its realisation. It was once again mooted in 1941; but the moment was not deemed ripe then for such action, partly because the leading spirits in almost every one of the Sub-Committees were unable to devote time and labour to bring their Reports up-to-date; and partly also because war-time restrictions or shortages had made scarcer than ever before the statistics and other facts, which particular sub-committees would need, to bring their work up-to-date. The war-time needs of Government had attracted several of them to work on Government Bodies, Panels, or Committees. For all these reasons it was deemed undesirable that material of this character—valuable as it must be—should be put out in an incomplete, inchoate, obsolete form, which may reflect unfavourably upon Indian capacity for such tasks.

The last four years of the War were thus a period of suspended animation for the National Planning Committee. Even after the end of the war, it has not been feasible, for obvious reasons, for the Planning Committee to resume its work and finalise decisions. Continuous sessions of that body are indispensable for considering and taking decisions on the Sub-Committee reports presented since 1940, and putting all the material into shape, ready for publication, not to mention making its own Report; but the political situation in the country made it impossible. Other conditions, however, are somewhat more favourable than in 1938-39, when the Central Government of the country were all but openly hostile to such attempts. Lest, however, the momentary difficulties make for needless further delay, it was thought advisable by the Chairman and the undersigned that no more time should be lost in putting this material before the Public. Following this advice, it is now proposed to bring out a complete Series of the National Planning Committee's Sub-Committee Reports, which will

serve as appendices to the Parent Committee's own Report. The Plan of the proposed enterprise is briefly summarised below.

Every Sub-Committee's Report, which is in a final form and on which the National Planning Committee has itself taken resolutions, will be edited and published, with an Introduction assigning their due importance to the suggestions and recommendations contained in that particular report, its proper place in the over-all National Plan; and following it up, wherever necessary, by a kind of Epilogue, summarising the developments that have taken place during the seven years, during which the work of the Planning Committee had been in suspension.

Those Reports, again, which, though in a final form, have not yet been considered, and no resolutions taken thereon, by the Planning Committee, will also be included in the Series in the form in which they were submitted, with such Introduction and Epilogue to each as may be deemed appropriate. And the same treatment will be applied to Reports which are 'Ad Interim', whether or not the Parent Committee has expressed any opinion on the same. They will be finalised, wherever possible, in the office, with such aid as the Chairman or Secretary of the Sub-Committee may be good enough to render. Sub-Committees finally, which have not submitted any Report at all, —they are very few,—will also find their work similarly dealt with. The essence, in fine, of the scheme is that no avoidable delay will now be suffered to keep the National Planning Committee's work from the public.

Both the Introduction and the Epilogue will be supplied by the undersigned, who would naturally be grateful for such help as he may receive from the personnel of each Sub-Committee concerned. The purpose of these additions is, as already stated, to assign its true place to each such work in the over-all Plan; and to bring up the material in each Report to date, wherever possible.

Not every Sub-Committee's Report is sufficiently large to make, more or less, a volume by itself, of uniform size, for this Series. In such cases two or more Reports will be combined, so as to maintain uniformity of size, get-up, and presentation of the material. The various Reports, it may be added, would not be taken in the order of the classification or grouping originally given by the Planning Commit-

tee; nor even of what may be called the intrinsic importance of each subject.

In view of the varying stages at which the several Reports are, for reasons of convenience, it has been thought advisable to take up for printing first those which are final, and on which the Planning Committee has pronounced some resolutions. Printing arrangements have been made with more than one Press, so that two or three Reports may be taken simultaneously and published as soon as possible so that the entire Series may be completed in the course of the year.

Two other Sub-Committees, not included in the list of Sub-Committees given above, were assigned special tasks of (1) preparing the basic ideas of National Planning; and (2) outlining the administrative machinery deemed appropriate for carrying out the Plan. These were unable to function for reasons already explained. The present writer has, however, in his personal capacity, and entirely on his own responsibility, published the "Principles of Planning" which attempt to outline the fundamental aims and ideals of a National Plan. This remains to be considered by the Planning Committee. Similarly, he has also attempted to sketch an administrative machinery and arrangements necessary to give effect to the Plan, when at last it is formulated, and put into execution. Notwithstanding that these two are outside the Scheme outlined in this Preface, they are mentioned to round up the general picture of the arrangements made for publication of the entire work up-to-date of the National Planning Committee and its several Sub-Committees.

The several volumes of Sub-Committee Reports, when published, will be treated as so many appendices to the Report of the parent body, the National Planning Committee. It is impossible to say when that Committee, as a whole, will be able to hold continuous sessions, review and resolve upon Sub-Committee Reports which have not yet been considered, and lay down their basic ideas and governing principles for an all over Plan, applicable to the country, including all the facts of its life, and all items making up the welfare of its people.

The disturbed conditions all over the country, and the Labour unrest that has followed the end of the War has caused unavoidable delays in printing and publishing the

several volumes in the Series, which, it is hoped, will be excused.

In the end, a word of acknowledgment is necessary to put on record the aid received by the Editor in the preparation and publication of this Series. All those who are associated in the task,—members of the Parent Committee, or as Chairmen, Secretaries or Members of the various Sub-Committees,—have laboured wholly, honorarily, and consistently striven to give the best that lay in them for the service of the country. Almost all Provincial Governments and some States,—the latter twice in some cases,—have made contributions towards the expenses of this office, which have been acknowledged and accounted for in the Handbooks of the Planning Committee, published earlier. Suitable appreciation of these will be expressed when the Parent Committee makes its own Report. At almost the end of its task, the expenditure needed to edit, compile, and otherwise prepare for the Press, the several Reports, has been financed by a Loan by Messrs. Tata Sons Ltd., which, even when repaid, will not diminish the value of the timely aid, nor the sense of gratitude felt by the undersigned.

Bombay, 1st July 1947. K. T. Shah.

CONTENTS

INTRODUCTION

This Sub-Committee was appointed by the National Planning Committee to consider the following Terms of Reference:—

(a) the present mineral production of India.
(b) the future possibilities;
(c) classification of the mineral resources essential for national defence and non-essential, and recommend the appropriate policy for each;
(d) present position of laws of mineral exploitation, and modification of them to suit our goal;
(e) present position of metallurgical industry,—ferrous and non-ferrous;
(f) national policy for use of metals in our industries looking into our national resources;
(g) best position of locating these industries and ways and means of developing them;
(h) national policy regarding import of minerals needed for national defence.

India does not seem to be too well placed in respect of mineral wealth, or the initial endowment of nature, at least in proportion to her size and population. From the point of view of intensive industrialisation that is a very serious handicap. If India is to adopt, as the goal of her industrial development, all of her available raw materials into finished goods ready for consumption; or, alternatively, to work up the raw materials available within the country into finished goods sufficient at least to meet her own requirements, without any dependence on foreign imports, industrialisation of all kinds must proceed at a pace and in volume hitherto unknown. And for that industrialisation to be achieved, it is indispensable that she should have, within her own frontiers, the wherewithal to make the necessary tools and improvements, plant and machinery. These are made out of metals or minerals; and the mineral resources available at the moment do not seem sufficient to meet all our requirements for realising the goal of industrialisation indicated above.

The approximate value of ores, minerals and metals, says the Report of the Industrial Panel on Non-Ferrous Metal Industries, which India has been producing of late, ranges from Rs. 30 to 35 crores per year. An analysis of the figure for the year 1937-38, the latest available, shows that to the

annual estimated aggregate value of our mineral industries, metals,—ferrous and non-ferrous—contributed Rs. 13 to Rs. 14 crores (about 40 to 43 per cent of the total). If we compare these figures with those of the corresponding commodities in the United Kingdom, Canada, South Africa and other industrially advanced countries, we would feel seriously disappointed in regard to this aspect of our native wealth, and the reaction upon our ambitions for industrial development in consequence.

According to official statistics, the total value of the mineral wealth annually produced was Rs. 34.14 crores in 1938. The publication of statistics regarding India's mineral production was discontinued during the war as a war-measure. But the demands made by the war resulted in a substantial increase in the mineral output. 92,694 workers were employed in mines in British India in 1943, as compared with 55,123 in 1939, the corresponding figures for Indian States being 6,583 and 5,090. The total value of Minerals produced in the country during 1937 and 1938 is as in the opposite table.

According to the Industrial Panel—non-Ferrous metals Industries—Report, already quoted, the estimated value of metals, minerals and mineral fuels, produced in the countries named below, was in 1935:—

United Kingdom	Rs. 220.87 crores of rupees.
Union of South Africa	Rs. 112.10 „ „ „
Australia	Rs. 28.01 „ „ „
Canada	Rs. 84.09 „ „ „
India including Burma	Rs. 26.01 „ „ „

This gives us the lowest position comparatively among the countries of the British Commonwealth and still more disappointing when considered relatively. The situation has improved since 1935, mainly because of the impetus given by the War. But even so our relative position continues to be the same, as elsewhere the War has stimulated the output still more intensively. The progress of this country in the matter of mineral production is extremely slow. Though the production in India between 1935 and 1942 rose by something like Rs. 10 crores, the development in the same group of industries in other countries was as follows:—

In Canada it rose to	132.6 crores in 1938
	141.0 crores in 1939
	169.2 crores in 1942

A similar progress is noticeable both in South Africa and Australia. These are countries vastly populated though of considerable area and therefore possess larger mineral deposits and initial endowment.

Minerals, Ores & Metals.	1937 (Revised)	1938	Variation per cent. (on rupee basis).
	Rupees	Rupees	
1. Coal	7,81,02,439	10,64,23,835	36.2
2. Steel	6,68,63,554	6,96,52,932	4.2
3. Manganese Ore (*a*)	4,29,53,068	3,92,94,763	—8.5
4. Iron (Pig iron) (*b*)	2,82,78,201	3,44,16,000	21.7
5. Gold	3,03,95,871	3,04,75,397	0.3
6. Petroleum	1,37,06,864	1,65,43,142	20.7
7. Mica (*b*)	1,43,60,036	1,13,25,346	—21.1
8. Building materials	97,07,817	1,12,65,392	16.2
9. Salt	81,47,356	95,18,383	16.8
10. Copper	61,67,490	44,02,580	—28.6
11. Ferro manganese (*x*)	10,69,453	24,63,590	130.3
12. Ilmenite	11,26,329	1,,46,436	37.3
13. Saltpetre (*b*)	11,17,844	11,68,446	4.5
14. Kyanite, etc...	7,08,623	7,46,514	5.3
15. Chromite	8,35,589	6,82,502	—22.4
16. Clays	3,25,578	3,76,270	15.5
17. Monazite	1,40,365	2,33,700	66.4
18. Gypsum	1,18,543	1,71,903	45.1
19. Steatite	1,55,221	1,68,580	8.6
20. Magnesite	1,63,938	1,60,593	—2.0
21. Fuller's earth	75,017	78,958	5.2
22. Diamonds	54,979	68,813	25.1
23. Zircon	39,036	40,737	4.3
24. Silver	32,343	29,877	—7.6
25. Barytes	1,49,260	29,312	—80•3
26. Ochres	28,193	28,865	2.3
27. Bauxite	61,839	25,540	—59•1
28. Graphite	16,302	20,691	26.9
29. Iron-Ore (agaria)	1,062	12,690	1,093.9
30. Tungsten-ore	24,500	9,600	—60.8
31. Asbestos	6,022	4,482	—25.5
32. Felspar	3,390	4,335	27.8
33. Beryl	1,969	1,597	—18.8
34. Garnet sand	1,650	600	—63.7
35. Bentonite	900	330	—63.3
36. Corundum	....	250	100.0
37. Sapphire	550	150	—72.7
38. Apatite	1,660	119	—92.8
39. Copper-ore	....	101	....
40. Aquamarine	....	14	100.0
41. Tantalite	301	....	—100.0
42 *Antimony-ore	....	....	....
Total ..	30,49,43,161	34,13,93,365	11.9

(*a*) Export f.o.b. values. (*b*) Export values. (*c*) Revised.
*Underestimated.

Admitting our initially poor endowment, so far as is known today, the known or available mineral resources of India have not been developed with the intensity they demand, if the objective of National Self-sufficiency in the matter of industries is to be attained. For machinery is among the prime requirements of modern industry; and if that cannot be made at home from indigenous resources, the realisation of our goal would be wholly illusory.

The Panel referred to has explained this relatively backward condition in the state of things on the following general grounds namely:—

1. Lack of policy and organised plans for prospecting, mining, and utilisation of minerals.
2. Lack of effective State control, assistance, and encouragement.
3. Absence of basic industries.
4. Lack of trained men and technical skill.
5. Want of reliable information on the industrial application of minerals.
6. The haphazard mining of the ore bodies, with an eye for immediate gains leading to the rapid depletion and waste of the useful portions of the deposits.
7. Inroads of foreign firms who have taken up concessions for most of the important Indian minerals.

Indian opinion is convinced that the British Government, while it held power in this country, was deliberately inclined to put a brake upon the progress of Mining and Mineral or Metallurgical Industries in the country. For if India attained a degree of self-sufficiency in the matter of minerals to meet her own demands in respect of tools, implements or machinery, a very considerable market for Britain's own production would be lost. There was consequently no policy to develop the existing resources, which, if adequately and effectively developed, might suffice for our needs in the initial years at least. And wherever such development has taken place, the concessionaire has been a non-Indian usually, with the single exception of the Tata Iron and Steel enterprise.

The War, however, forced the hands of the Government in power and a considerable impetus was given to the industry to meet from Indian resources the war-needs of the Allies in the Eastern theatres, Indian industry soon responded, and showed that if only proper tools, technique and machinery, plant and equipment were available; if a reasonable policy of prospecting, exploring and exploiting of all known or possi-

bly available minerals were resolved upon; and if the Government Department responsible were to provide all the necessary aid, encouragement, assistance, and protection, to the backward industry to develop, the mineral wealth of India would not prove utterly inadequate to the requirements of the country, at least in the initial stages of her planned, intensive, industrial development.

One factor responsible for the relative backwardness in exploring the available minerals, and developing such as are found, may be traced to the policy of the British Government in India to grant mineral concessions almost entirely to private,—and that too to non-Indian,—enterprise. The mineral wealth of the country, however, is a gift of nature, a part of our initial inheritance, which belongs as much to the present as to succeeding generations. The industries, moreover, founded upon such materials, are among the key or mother industries, whose benefit must be available to the whole country, and not only a fortunate few who make profit for themselves out of what is common property. Private enterprise ought, therefore, to be barred from prospecting for or exploiting mines and minerals, or developing the vital industries on which may depend the very life of the country. And even if in any sector, such enterprise is for any reason unavoidable, at least for the time being, it must be confined strictly to the natives of the soil. No non-Indian should be given a prospecting license, or concession for working any form of our mineral wealth. And if there are actually in existence non-Indian interests in any part of this field, they should be immediately acquitted by the State; and that industry be conducted by the State as a collective public enterprise. One of the first tasks of the National Government of a free India, and its Planning Authority, would, therefore, be to make it clear beyond mistake that this natural wealth of the country must be developed by the Nationals of the country, and for the benefit of the country and not by any particular class within it. Any existing foreign concessions, no matter for what term granted, must be brought within the control of the National Planning Authority at once, so that development may take place as an integral part of the National Plan side by side with other departments of the Plan. The kind of concession, illustrated by that granted by the Punjab Government in 1937 to the Imperial Chemicals (India) Limited, cannot but end in disaster to any ambitions India may entertain of taking her due place amongst the industrial nations of the world. Only if this group of industries, so vital to the very existence of the country, especially in the matter of national defence, are owned, controlled and

worked by the State collectively, and for the benefit of the community as a whole, will there be any hope of reasonable development within a measurable time, so as to be in keeping with the social and economic development on other fronts. It is only then also that it will be advisable to afford protection, encouragement, financial assistance and technical aid which the large-scale establishment of these industries would necessitate, if they are to keep their footing in the face of many adverse factors.

Mineral Position of India

This does not mean, of course, that India's ambitions for intensive and all-round industrialisation are fated from the very start to disappointment. The backwardness in regard to mineral wealth is only relative, not absolute. According to the Industrial Panel,—Non-Ferrous Metals Industries—Report, quoting Mr. D. N. Wadia, Mineral Adviser to the Government of India, and Chairman of the National Planning Committee's Sub-Committee on this subject:—

"There is no justification for the widely prevailing opinion that India is poor in her mineral resources for developing large-scale non-ferrous metal industries. It is the usual practice in India to dismiss, without detailed prospecting, non-ferrous ore deposits which occur in a scattered or disseminated state as not worth the attention of modern metal miner or smelter. This practice has worked to the detriment of the industry, since an ore deposit, having once been rejected, as too small or uneconomic to work, has never again been touched for further prospecting in spite of wide-spread evidence in the form of slags and mines dumps indicating the deposit having been worked by the ancients. The attention of the Geological Survey of India has hitherto been confined to the more immediately paying and larger metalliferous deposits, the less extensive deposits receiving hardly any attention. A systematic prospecting for metallic ores has never been attempted in India; and hence the information available to the Panel has been sketchy and incomplete."

The relative position of India with regard to supply of industrial minerals has been given by Mr. D. N. Wadia* the Mineral Adviser to the Government of India, as follows:—

1. Minerals of which our exportable supplies can dominate the world market:—

   Iron ore, Titanium ore, Mica.

*The Mineral Outlook In India by Mr. D. N. Wadia, Science and Culture Vol. VII, pp. 515-518, 1941-42.

2. Minerals of which our exportable surplus forms an important factor:—

1. Manganese ore
2. Bauxite
3. Magnesite
4. Refractory minerals
5. Silica
6. Gypsum
7. Monumental granites
8. Natural abrasives
9. Monazite
10. Beryllium
11. Corundum
12. Steatite

3. Minerals in which India may be considered self-sufficient for present needs and those of the immediate future:—

Coal
Cement materials
Aluminium ore
Gold
Copper ore
Chrome ore
Building stones
Marble
Slate
Industrial clays
Limestone and Dolmite
Mineral Pigments
Sodium Salt and Alkalies
Borax
Felspars
Nitrates
Phosphates
Zircon
Arsenic
Antimony
Barytes
Precious and semiprecious stones
Vanadium
Rare Earths

4. Minerals for which India has to depend largely or entirely on foreign imports:—

Silver
Nickel
Petroleum
Sulphur
Lead
Zinc
Tin
Mercury
Tungsten
Molybdenum
Platinum
Graphite
Asphalt
Fluorides

Distribution of the available Mineral Wealth as between India and Pakistan

"It may be interesting to note, in passing, the distribution of the available mineral wealth of the country as between the two divisions of the land made since August 15, 1947. According to an article by Charles H. Behr, Jr. in the *Foreign*

Affairs for October, 1943, the principal minerals were distributed as follows:—

I *Coal*
Assam Field
Central Provinces
Wardha Gondwana
North Bihar Field
Raniganj ,,
Johilla ,,
Karampura ,,
Jharia ,,
Bokarao ,,
Bikaner ,,
Jammu ,,
Mianwali ,,
Quetta ,,
Dando ,,

II *Petroleum*
Digboi (Assam)
Badarpur
Khaur
Dhulian-Charar (Punjab)

III *Ferrous Metals*
Iron Ore Regions
Mysore
Chanda
Singhbhum Keonjar

IV *Manganese Ore*
Nagpur
Garha
Vizagapatam
Goa
Bihar

V *Chromium Ore Regions*
Mysore
Nanjungad

VI *Gold Regions*
Kolar (Mysore)

VII *Bauxite Regions*
Jammu
Katni
Belaghat
Mamni
Lahardaga
Kolhapur
Belgaum

VIII *Copper Regions*
Singhbhum

IX *Magnesite Regions*
Salem
Mysore

X *Mica Regions*
Champaran
Nellore

"Any one acquainted with the geography of India will easily perceive from this that the bulk of the Mineral wealth of the country, such as it is, is to be found in India. The writer of the Article quoted accepts the boundaries of the two Dominions, as originally demanded by the Muslim League. But according to the agreement of June 3, 1947, these boundaries have been redrawn according to the credal complexion of the majority of the population. Hence, much of the Bengal Coal and Assam Oil come to India, leaving Pakistan proportionately poorer. In the present writer's *Why Pakistan? And Why Not?* from which the above has been taken, it is said:—"India as a whole is lamentably short in phosphate resources. In any ambitious scheme of national planning, including agriculture, these will have to be imported in large quantities. Bihar and Orissa have some minor phosphate

resources, and so to a still more insignificant extent has the Punjab in its coal-bearing shale. But the chief source of this material,—natural or artificial,—is Hindustan, not Pakistan; or, if imported, will have to come through Hindustan ports. Another fertiliser, potassium, is to be found equally in both divisions." (pp. 134-6).

In regard to such items in the list of minerals as we may be particularly deficient in, the development of known resources may make up the deficiency; or we may find substitutes. Thus in regard to iron, India produced during the War nearly 3 million tons of ore; while of steel we made 1½ million tons. Coal has touched 28 million tons and possibly more. In regard to coal, moreover, as a source of energy, we have an alternative in hydro-electric energy, which has been more fully considered in another volume of this Series, namely that on Power & Fuel. Even as against Iron and Steel an alternative may be found in the fuller development of aluminium, Bauxite deposits are available in more than one part of the country. Once adequate power supply is available, it is not at all inconceivable that Aluminium may be developed in the coming future, if not to replace Iron and Steel altogether in modern industry, at least to become a most effective supplement. The same may be said with regard to such other articles as Petroleum in which we are deficient. But substitute for it can be found in electricity or power alcohol apart altogether from discovering new fields. Of salt we have fairly sufficient quantities.

Non-Ferrous Metal Industries

The non-ferrous metal industry is closely tied to the mineral industry and hence a brief outline of India's mineral position as at present known is given. India possesses vast deposits of Bauxite, Magnesite, Beryllium, Manganese ore and Titanium ore. With regard to ores of Antimony, Chromium and Vanadium the position may be regarded as satisfactory. However very few workable ore deposits of the important industrial metals like Copper, Lead, Zinc, Tin, Nickel, Tungsten and Molybdenum have been discovered so far. This does not indicate that there are no ore deposits of these metals in India, since India did maintain a prosperous indigenous non-ferrous metal industry in the past. Compared to U.K., Canada, Australia and South Africa, the progress of India's mineral industry during the last 50 years cannot at all be regarded as speedy or extensive.

Before the war, non-ferrous metal industry was almost non-existent in India and almost all her requirements were met by imports. To help the war effort a few refining and

semi-manufacturing plants have been put up which should form the nucleus for a sizable non-ferrous industry in India. Today India produces about 6,000 tons of fire-refined Copper, 2,400 tons of Aluminium, 250 tons of Antimony and 100 tons of lead per year. Compared to India's total consumption of non-ferrous metals this production is very insignificant with the exception of antimony.

Production and Fabrication of Non-Ferrous Metals in India

In regard to Non-Ferrous Metal Industries the present position is classified into the following four groups by the Panel referred to above.

1. Primary production, or production of virgin metals, from Indian ore deposits.
2. Secondary production, or reclamation of metals and alloys from non-ferrous scrap.
3. Processing of primary or secondary metals, and alloys into semi-finished materials like sheets, rods, pipes, tubes, wire, etc.
4. Fabricating and casting industries making finished products out of sheets, wires, etc., and castings out of primary or secondary metals and alloys.

Primary Production

The only primary metals produced in India are copper, aluminium, antimony, and small quantities of lead. The present production is as follows:—

	Annual production in Long Tons.	Percentage of present annual consumption.
Copper	6,000	15 to 20
Aluminium	800 (from Indian Bauxite) 1,600 (from imported Alumina)	
Antimony	250	75
Lead	100	less than 1.

Evidently the present production of primary metals is not large. Copper was the only metal smelted in India before the War. Aluminium, antimony and lead only began to be produced during the War. Almost all the pre-war requirements of non-ferrous metals, valuing over 10 to 12 crores of rupees per annum were met by imports. Neither Copper, however, nor aluminium were produced in anything like their full potential; while, in the case of copper, the basic exploitation is in the hands of a non-Indian concern.

Secondary Production

Even in countries producing large tonnage of virgin metals, the recovery of metals from scrap is a highly organised industry. It was only during the War that India began to pay any serious attention to refining of scrap metals, which were originally exported to countries like Japan. Several firms are now engaged in the refining of white and yellow metals. Their potentiality is by no means negligible. Being industries started during the War on the assurance of Government of adequate protection after the War to enable them to make good their existence in an era of revenue competition, they have applied to the Tariff Board established soon after the War was over, for protection and safeguard; and their case has met with sympathetic consideration from the Tariff Board.

Processing of Primary or Secondary Metals

The semi-manufacturing industry has largely been developed during the War, when sources of imports were totally cut off and the country was forced to rely on her own resources to meet her essential requirements. In spite of handicaps connected with imports of heavy machinery, India was able to meet most of the defence requirements in respect of sheets, rods, wires etc. of aluminium, copper and brass.

Most of the leading semi-manufacturing firms have plans for installing modern plant and equipment. It is very likely that within five years India will be able to meet all her requirements of semi-manufactures, such as sheets, strips, foil, rods, tubes, shapes, wires and cables, etc.

In this connection it may be pointed out that the Railways will continue to be one of the major users and semi-manufacturers of non-ferrous metals. It is, therefore, essential that their non-ferrous foundries and workshops should be installed with modern plant and equipment for the proper and economic production of the various requirements. The Railways should, moreover, depend on indigenous industries for their requirements and not on imports from other countries. If by such means an adequate home market is effectively secured to indigenous industry, its contribution to the goal of industrialisation and national self-sufficiency would not be inconsiderable.

Fabricating and Casting Industries

Large-scale fabricating industries are limited only to the manufacture of aluminium and brass utensils. Small non-ferrous foundries are scattered all over the country, but only a few of them produce articles of industrial value.

It is obvious from a very brief survey of existing non-ferrous industries that, up to date, their development has been meagre. Import was the chief feature of the metal industry of India.

Legislation Governing Mineral Development

India's organisation or machinery for discovering and developing her natural resources of minerals, and basing or expanding new or existing metal industries on the same, suffers from the same handicap as that in regard to the country's general policy in this behalf. The State during the British regime has been indifferent, if not positively hostile, to the establishment of those industries in their full potentiality, and the development of those resources in the country. Now, however, that the Government of the country is at last free, and in the hands of Ministers responsible to the chosen representatives of the people of India, it is imperative that the basic policy, and the legislation giving effect to that policy, must be radically re-defined, with a definite impulse to redress the past wrongs, and intensively explore and export the resources, and develop industries based thereon.

The guiding principles of such development and exploitation have already been indicated. The need for an up to date Geological survey of the country, to provide the primary data needed for such development, has been emphasised by every Conference of scientists interested in the subject, every committee of official and non-official experts who have investigated the problem, whether in regard to individual minerals, or as a general problem in the task of assuring National Self-sufficiency. Such surveys as have been made, and information collected therefrom more than half a century ago, are out of date. And during that period science has made such strides, and the technique for finding and extracting minerals has grown so rapidly, that the data drawn from the Nineteenth century surveys, and methods of extraction or development prevalent in those days, are bound to yield poor results. One of the first tasks, therefore, of the National Planning Authority, in this sector of our National Plan, must be immediately to organise an up to date survey and devise new machinery for rapid and intensive development of the known or newly discovered resources.

Basic Policy

Meeting this overdue need of India's national economy, the Planning Authority must see to it that the policy of absolute and complete reservation of our mineral resources, to be developed in the collective interests of the country, by its

organised representative, the State, is clearly enunciated and universally enforced. The State discovering and developing these resources may be the Central Government of India, or the Government of any component unit of the Indian Federation; or even a specially created Statutory Corporation set up for the purpose. There must be no room in this programme of nation building for private profit-seeking enterprise to have a footing. Such private enterprise as has already taken root, whether Indian or foreign, must be immediately acquired, with such compensation, if any, as may be deemed just and appropriate. Such a policy is indisputable for this particular branch of our industrial development, because of the intimate connection of Mineral and Metallurgical Industries with the tasks of National Defence; as also because of their vital role in the national development and because metallurgical industries are both vital and key industries; and, as such, the only proper authority to develop these branches of the National economy is the State. Then only can the benefit of such development be uniform, and be shared alike by all parts of the country, and all sections of her people. As these industries, moreover, are relatively new, they would need protection and encouragement in every form the State can devise, and would have to be given to the maximum degree necessary. Such protection would entail considerable cost or sacrifice to the community; and it is but fair that the benefit resulting, whenever it happens, should be for the whole country and every part of it alike.

Foreign Enterprise in Mining, Minerals and Metallurgy

Discovery and exploitation of Mineral, and the metallurgical industries founded on them, being reserved exclusively for the State in India, it follows that no non-Indian can have any place in such enterprise,—except, of course, as technical adviser or experienced personnel. There is a considerable amount of foreign capital and enterprise in this vital field at present. That will have to be immdiately acquired, on such terms and conditions as may be deemed just and proper. India cannot afford to leave such vital matters affecting her very existence as a nation and all her ambitions to intensive industrialisation or management of aliens, whose interests may, quite conceivably, be not in harmony at any given moment with those of this country. Mining of all kinds, therefore, and all metallurgical industries, with special reference to those relating to National Defence, must be exclusively a public monopoly, in which no alien interest should be permitted as owner, controller, or manager. Even where for-

eigners are engaged as technical advisers, or experienced helps, care must be taken at every stage that no chance is offered, no room is left, for sabotage at any point, or wilful retardation of any kind. Needless to add, such non-Indian personnel will be engaged only when and where absolutely unavoidable; and then, too, on specific contracts for given terms not exceeding five years. During that period it may well be hoped Indians of the requisite knowledge, skill, and experience, will be trained up in sufficient numbers to take up all the places occupied by foreigners to start with.

Location of Metallurgical Industries

The term in the Reference to the Sub-Committee concerning location of such industries is for experts and experienced managers to determine. So far, however, as mining is concerned, the site will be determined by the deposit available; and, as such, the question of location will not arise. As for the industries based on mineral deposits the presence of the raw material will, no doubt, be a governing factor in establishing the industry working up such deposits. Another consideration, which may affect the problem of location of the metallurgical industry, is the interdependence of all industries, and the advantages to be gained from a certain localisation by way of mutual help and specialisation. If industries were scattered and isolated they would be unable to command such advantages. More important, however, than these techinical and economic considerations are the considerations of national defence. In these days of aerial bombing of industrial centres immediately hostilities commence, it would be obviously unwise to concentrate our entire industrial potential in a few places. The more diffused the nation's industry, the more would be its capacity to offer effective resistance against any aggressor. Economic factors like transport costs and markets cannot be ruled out. But political considerations, also, cannot be ignored. Location would consequently be determined in each case with due regard to all these factors, which the Planning Authority will have carefully to evaluate and strike a balance.

The place of Iron and Steel Industry in the planned economy of India has been considered in another volume in this Series, viz. that dealing with the Engineering Industries and Industries connected with the production of Scientific Instruments, Apparatus and Appliances. The prospects of the Non-Ferrous Industries, and the place they ought to occupy in our planned economy which aims at achieving National Self-sufficiency as far as possible, will be considered more fully in the Summary of Developments at the end of this volume.

There remains, therefore, only to be considered the nature of our national policy in regard to imports of minerals required for national defence. There can, of course, be no question but that metals and minerals needed for this purpose, and not found or developed in this country, must be imported. No duties or other restrictions ought to stand in the way of such imports. It must, moreover, be a fundamental principle of national policy that all Defence Industries,—however the term may be defined,—must be owned, controlled and managed by the State in India directly as public monopolies. It would be an inescapable corollary of this principle that all the necessary requisites of such industries must also be under the ownership and control of the State. If any part of the raw material, accessory or plant has to be imported, it must be indented and obtained by Government agency. To do this most advantageously, the State may enter into mutually advantageous treaties or agreements with the countries able to supply these requirements.

In these ways only can an adequate and sufficient development of all mining and metallurgical industries take place, in the shortest time possible, so as to enable India to reach as high a degree of national self-sufficiency and planned economy as possible.

K. T. SHAH.

INTERIM REPORT

of the

MINING AND METALLURGY SUB-COMMITTEE

INTRODUCTORY

Mining and metallurgical industries are of great importance to India as through mining industry we obtain ores and metals, which are the starting point of several industries such as the heavy machinery industry and the heavy chemical industry.

The list of goods imported into India shows that more than 50 per cent of them are goods manufactured out of mineral raw materials. All the key industries of the nation depend upon the mineral raw materials. For the purpose of defence, these metals and mineral raw materials are absolutely essential as without them we cannot have armament, ammunition and fuels. Though in the total national production the amount of metals and other mineral raw materials may not be high, it is of vital importance to the nation. Till now much attention has not been paid towards the development of our mineral resources and whatever has been done is mostly due to foreigners. The production of the mineral wealth in India is controlled mostly by foreign companies which exclusively own deposits like those of coal, manganese etc. Whatever may have been done in the past, we have to see that in future there should be a vigorous development of our mineral resources by our own efforts for the interest of the nation. Till last year when the Congress Government came in power no province took any interest in the development of its mineral wealth. For example a province like Bihar which produces mineral wealth worth about 12 crores of rupees did not spend even a thousand rupees on the supervision, conservation and development of its mineral deposits. Till now these minerals have not yielded much revenue to the Provinces. The agricultural and forest products, though there can be renewal every year, have paid a very heavy taxation. Minerals are wasting assets and cannot be replenished again. The total revenue to all the provinces from the mineral production will not amount to more than a few lakhs of rupees at the most. Though there is a department

under the Central Government, called the Geological Survey of India, to look after the mineral wealth, its aims have been more scientific than economic. It has been mostly an advisory body having no executive authority and the interest of the Central Government has been more in its mind than the interest of the nation. The result of 80 years of working is that most of the minerals discovered have passed into the hands of foreigners. The function of the department has been to look after the royalty on the minerals rather than the conservation of the minerals. The other department connected with the mineral industries is the Department of Mines under the Government of India. There is no agency to look after the working of petroleum deposits. As far as the taxation is concerned, nobody has thought over it at all and there is no department whose function it is to look into the matter.

With proper development, these minerals can make the country self-sufficient for self-defence, can supply raw materials for the development of heavy industries like the electrical, mechanical and chemical ones, and can be a good source of revenue to the provinces. A greater part of the industrial planning depends upon the supply of these mineral raw materials, so we hope that a proper plan will be worked out for the development of these mineral raw materials.

II. AIMS & OBJECTS OF THE SUB-COMMITTEE.

The aims and objects of the sub-committee on broad lines are as follows:—

1. The stoppage of the export of key minerals and ores such as those of manganese, chromite, sillimanite, phosphorous and some refractory minerals.
2. Local manufacture of metals and products now imported from abroad from Indian mineral raw materials, such as aluminium, some light alloy metals, heavy machinery, heavy chemicals, mica goods, &c.
3. Suggestions for organising agencies for bringing about the above-mentioned developments.
4. The question of framing a tariff policy on mineral export and import.
5. The question of mineral taxation.
6. The question of starting and developing mineral industries.
7. The question of development of mineral industries for the purpose of self-sufficiency in national defence.

III. NON-METALS.

About non-metals the sub-committee passed the following resolutions in some of the meetings it held.

1 The country should be made self-sufficient as far as salt is concerned and there is a practical possibility of doing it.

2. Efforts should be made to try to improve the quality of salt in Madras, so as to replace the salt imported from Aden and Liverpool by Bengal at present.

3. The question of purification of salt should be left to the Chemicals Sub-Committee, to study the whole thing, and try to improve the quality of salt.

4. It is desirable that each and every province should have a complete study of the salt resources, so that in time of emergency they may use them.

5. The question of the by-products in the salt industry deserves careful consideration and the provincial governments should go into the question of utilising these by-products. Research should be undertaken in each province as regards the by-products in the salt industry.

6. Attempts should be made to find out and utilise, as far as possible, raw materials like pyrites, gypsum, &c. for the manufacture of sulphur.

7. We should try to benefit by the researches made in other countries to use gypsum for the manufacture of sulphur, by manufacturing sulphur dioxide from gypsum and then reducing it to sulphur so that the country can be made self-sufficient as far as sulphur is concerned.

8. Any sulphur that is wasted in roasting pyrites should be utilised for the manufacture of sulphuric acid and for this purpose Government should take steps to see that sulphur dioxide does not escape and pollute the atmosphere besides causing the wastage of sulphur. Provincial Governments should bring in legislation in this respect.

9. Thousands of tons of scrap mica in Nellore (Madras) and Hazaribagh (Bihar) Mines remain unutilised, which is a great national waste. The sub-committee recommends to the Provincial Governments of Madras and Bihar that immediate steps be taken to eliminate this waste, and acquire the waste mica to start the manufacture of—

i. micanite,
ii. other electric insulators from ground and
iii. potash from muscovite mica.

If the State cannot take up the work, it should work out all the details to start this industry, and hand it over to some private enterprise, and help it to acquire and utilise all the waste mica.

10. The manufacture of the following synthetic fertilisers is practicable and it is recommended that it should be started immediately :

a. Nitrogen carrying fertilisers like calcium ammonium nitrate from coal or hydro-electric power where the same is cheaply available.

b. Phosphatic fertlisers from apatite, bone meal and basic slag.

c. Potassic fertilisers from the waste bitterns in the Lonar Lake and the salt mines of the Salt Range. If the need of potash be found greater, steps should be taken to study the question of extraction of this salt from minerals containing it such as mica, felspar, granite &c.

d. Conservation of phosphatic materials existing in the country, by restricting exports, for example the export of apatite and bones. India's export of bones amount to 61,000 tons per year valued at 44 lakhs of rupees. It is extremely desirable that this export of bones should be restricted and it should be turned into super-phosphates. This step is essential because India is rather poor in phosphatic fertilisers.

e. Utilisation of vast deposits of gypsum for industrial purposes, for example treating lime-poor soils, or alkaline soils.

IV. METALS.

The Sub-Committee agreed that it should recommend the starting of Companies in places where cheap electric power was available for the manufacture of alloys taking the ores from concerns like the Tatas, and it was suggested that if such ferro alloys were sold to the Iron and Steel Companies in return for the ores, they could develop their Iron and Steel Industry.

Regarding aluminium also India had large reserves. At the present time there is unrestricted export of many important key minerals which require check.

The following are considered necessary:

1. Ferro alloys should be manufactured in India with a view to meet the internal demand for the manufacture of alloy steels.

2. Production should be increased with the starting of new steel industries.

3. Ores of national importance should not be allowed to be exported, so that the future requirements of the country may be met from the reserves.

4. In the case of imported minerals like nickel, tungsten &c. which were not found in sufficient quantities in

India, some kind of bartering arrangement should be made with neighbouring countries like Burma.

5. It would be a national policy to extend the use of aluminium wherever possible.

6. The manufacture of ferro-titanium as a by-product in the aluminium industry should be taken up. This material should be employed in the electrical industries as far as possible, as the supply of copper in India is deficient.

7. A detailed investigation of the copper deposits is essential as at present about two-thirds of the total need of copper in the country is met by imported copper.

8. The tin deposits of the Gaya district (Bihar), the iron arsenite in Bihar and Chitral deposits of stibnite should be investigated.

9. The scrap (ferrous and non-ferrous) in the various provinces can be locally smelted in places where cheap electric energy is available.

The following decisions were arrived at:—

1. Every effort should be made to replace the domestic requirements of household utensils by aluminium alloys and that experimental investigation should be undertaken to find out special alloys which would stand rough use and corrosion &c.

2. On account of the growing importance of alloy metals investigation of magnesium deposits and the manufacture of aluminium-magnesium alloys should be undertaken and this should be considered in connection with the motor car manufacturing industry.

3. The question of the study of the important metallic minerals in the countries surrounding India e.g. Tibet, Burma, China and Ceylon should be properly gone into.

4. The question of restriction of the export of beryllium, an important metal, requires consideration.

5. Information regarding the amount of coinage used in India with a view to replace copper coins with local metals like aluminium is required.

V. FUELS.

Indian coal is the cheapest in the world. So the products derived from Indian coal would be the cheapest in the world. So industries which require much coal should be started near the coal mines. They could also make such things as synthetic petrol, coal-tar by-products, synthetic ammonia &c. from coal.

The coal should be substituted by other materials as far as possible as by doing so the reserve will not be exhausted quickly. Hydro-electric energy, where cheap and economi-

cal, should be used in place of coal. This is possible especially in provinces away from coal fields. For the generation of power charcoal is also to be used. The coking coal reserves being limited, coking coal should be used only where it is absolutely essential, such as metallurgical industries. To bring this restriction on the use of coking coal, necessary legislation should be brought. All the by-products should be utilised and the wastage should be disallowed by law.

The Sub-Committee recommends that the Provincial Governments, in framing their road building programme, should keep in view the presence of coal and other mineral deposits and the need of their development.

The Sub-Committee recommends the substitution of petrol by industrial alcohol and bringing legislation for the purpose. Charcoal and wood should be used as substitutes for petrol in automobiles as is done in France.

VI. OTHER RAW MATERIALS.

The Sub-Committee is of opinion that India possesses all the raw materials for glass industry except soda ash which could be manufactured from limestone and salt which are found in plenty in India. Thus by developing the glass industry and manufacturing soda ash in the country, India can easily be made self-sufficient as far as glass is concerned. The resources of reh and other things for the glass industry should be investigated.

The supply of borax from Tibet should be scientifically organised. The question of the supply of potash nitrate in India is very important as the import of this material and other potash salts from Germany has been cut off due to war.

Synthetic fertiliser industry should be started and developed in India, for which there is a very good chance of success.

The conservation of phosphatic minerals existing in the country is absolutely essential.

VII. ORGANISATION OF STATE AGENCIES FOR MINERAL DEVELOPMENT.

All Provinces and States should start Mineral Departments whose duty it should be to make a vigorous investigation of the mineral resources of each Province or State in detail, which should be planned on a ten year basis. This Department should conduct a survey of mineral occurrences which should complete all the important work within at least ten years. The department should look after every kind of work in connection with mineral development. The money invested in the development of minerals will bring a return

of many times the investment as in the Agriculture or Forest departments.

A Central Mineral Research Council should be created and it should be composed of all the representatives of the different Provinces and States, and non-officials connected with industries, representatives of Universities &c. on the lines of the existing Agricultural Research Council.

A Central Research Institute should be started which should be financed by the different Provinces and States. The research work undertaken by the Council suggested above, should be carried out either in this institution or in other institutions existing which are equipped for the work.

The Sub-Committee feels that the existing Geological Survey of India staff consisting of 25 members is too small for carrying out a detailed survey of a country like India. Moreover, the Geological Survey of India is under the Federal Government and so sometimes the interests of the Provinces and the Federal Government clash. The work of the Geological Survey of India is rather scientific than economical. It is not paying enough attention to prospecting, and developing the mineral deposits. Under these conditions it is suggested that each Province and State should organise a separate department for looking after this kind of work.

Till such time as a Central Mineral Research Council for the whole of India is created, a provisional Advisory Board should be set up consisting of the Mining and Metallurgy Sub-Committee of the National Planning Committee with its headquarters at Benares. The function of this Board will be to offer free technical help, advice and information to Provincial Governments, States, companies and private concerns or to deal with any other matters connected with mineral development. The Board should do free work not requiring monetary outlay in experiments &c. For detailed investigations, trials, tests, field operations, &c. the Benares Hindu University should be requested to give the services of its laboratories and research staff to this Council. With the sanction of the authorities of the University and provision of facilities, such research work and experiments may be carried out in the laboratories of the Benares Hindu University and such fees, honoraria &c. as may be realised may be credited to the University, to the Departments concerned. The Secretary of the Board will work as a liaison officer in collecting information from different members of the Board as well as from other specialists throughout India and abroad concerning literature. The Provinces may be requested to give small financial assistances for the efficient functioning of this Board. The institution of such a step will

be the first step towards the rise of a prospecting and mining industry in most of the Provinces of India.

VIII. INDUSTRIES FOR NATIONAL DEFENCE.

No member of the Sub-Committee has adequate practical experience about the details of defence requirements. It is difficult to make definite recommendations regarding the minerals needed for this purpose. This work may be assigned to a Committee of experts, both Foreign and Indian, if possible. The Government may also be approached to give us an idea of the extent of various minerals required for defence purposes. Only after obtaining much detailed information can a regular plan for industries needed for defence be drawn up. It is felt by the Sub-Committee that an estimate of production and imports of minerals of the more important foreign countries would also be helpful.

The materials required for national defence are fuel (mostly petrol), armaments, munitions, and explosives &c. The country should be made self-contained as far as petrol and other fuels are concerned. For this purpose synthetic petrol industry should be developed. The Committee is of opinion that we are in a favourable position for the manufacture of aeroplanes as we have got vast resources of aluminium, magnesium, beryllium &c. We have got almost all the minerals required for armament industry. As lead plays a very important part in war (as bullets for example) special efforts should be made to arrange for its supply. Mercury (often used in the manufacture of bombs) also requires similar attention. The manufacture of acids, and other chemicals is also of vital importance to defence. Coal distillation industry which can supply a lot of peace time needs like synthetic fertilisers, can supply a number of chemicals needed in war. The question of poisonous gases deserves careful attention and for this purpose assistance should be taken from foreign experts.

It is very difficult to make much distinction between the requirements of war and peace time. Hence the industry should be so organised that it may be possible to shift immediately, when necessity arises, from peace to war requirements.

IX. TECHNICAL EDUCATION FOR MINERAL INDUSTRIES.

One of the institutions existing in the country should be made most up-to-date by providing ample grants by the respective Governments. Such an institution should cater to the need of all the Provinces and States. In the opinion of

the Sub-Committee there are at present only two institutions which can take up this work; they are the Indian School of Mines, Dhanbad, and the Benares Hindu University. In the Indian School of Mines there is also a Department of Geology. In the Benares Hindu University higher studies are being given in all the three subjects, Geology, Mining and Metallurgy.

As regards courses in mining and metallurgy there are four kinds of labour required:—

1. Unskilled labour,
2. Skilled labour,
3. Supervisory staff,
4. Higher technical staff.

Skilled labour can be recruited from the unskilled labour when it has worked for a number of years and acquired experience.

The question of supervisory and foremen class of workers, requires much attention. At present the majority of the foremen are scientifically poor and are unable to grasp the idea of mineral conservation and other modern ideas of mineral development. Hence these men should be drawn from persons trained in the subjects in some of the Colleges.

At present there are two or three institutions giving training in these subjects and are sufficient to cater for the present demand of the country. If by law, it becomes essential to employ these trained graduates on supervisory posts, the efficiency of the industry is bound to develop, besides providing employment to many persons. It is also necessary to find more funds to make more efficient arrangement for teaching in these institutions. Though the mineral production of India is of the order of 32 crores of rupees, the money spent on education in the subject is very meagre.

At present, difficulty is experienced in arranging practical training of these persons. In the first place, leading mines and metallurgical works should be encouraged to provide facilities for thorough practical training in all branches. If need be, some kind of pressure should be put by the State on the manufacturer to provide facilities for such training.

These graduates may be employed on a starting salary of Rs. 75|- per month or so and should rise in course of time, as after sufficient experience they will be able to take up work of a more responsible nature. If there is greater demand for trained personnel, then the number of students in the existing institutions may be increased or new institutions opened.

At present, the question of mine management in regard to coal is well organised, but as regards the non-metallic minerals and the building materials and headquarters,

very little attention has been paid. As these are also very important and are growing in importance and to a certain extent are dangerous to the labourers, it is essential that proper steps be taken to provide trained men for these mines and quarries also. At present, there are no rules and regulations for a great number of quarries and mines, e.g., limestone, clay etc., where all kinds of persons are appointed. Some kind of legislation is essential so that only trained men may control these industries.

There are several allied industries such as refractory fuels &c. which are common to several industries. It is essential that there must be proper arrangements for providing sufficient inspection for these, which can only be done by having a separate department. Although fuel is so important for India, till now there is no provision for advanced training in the subject of fuel technology in India. It is extremely essential that a course for training in fuel technology should be started.

X. THE QUESTION OF MINERAL TARIFF

It was agreed by the members of the Sub-Committee, after considering the various memoranda prepared by the members and the views and suggestions put forth by Dr. Dubey, that the recommendations should be mainly on the followning lines:—

(a) stoppage of unrestricted flow of key minerals out of India, without a compensation return of equally important products.

(b) examination of the current tariff, and suggestions for its improvement, as far as minerals and their products are concerned. A study of the tariff policy of Australia, South Africa and other self-governing countries, in order to frame an appropriate policy for India.

It was thought desirable that a definite tariff policy should be framed with respect to the following:—

(i) For minerals for which India holds almost a monopoly, and which are being exported at a wasteful rate without any duty at present, like mica, ilmenite, titanium oxide, beryl, etc.

(ii) For those minerals for which India holds an excess of supply and plays an important part in the world production like iron ores, manganese ore, mangesite; sillimanite, kyanite etc.

On account of the great importance of tariff on ores and minerals, which are a wasting asset of the country it is essential that the question of tariff on minerals and their products should be examined in detail, a subject which has not receiv-

ed any attention till now, and that a Tariff Board instituted for the purpose or any similar agency should have a due representation of members of this Sub-Committee, or of any other future National Committee for mineral development that may succeed it.

It was thought desirable to find out whether the present Government of India Act gives the Provinces the right to regulate the output, as well as authority to impose a tax on the output of key minerals, should such output be injurious to national interests.

In the case of metals and minerals which are partly produced in the country and partly imported and on which there is a custom duty on import, the local manufacturers take the advantage of this custom duty for fixing their prices at the higher level. So the question of some kind of excise duty equal to the custom import duty should be taken to develop poorer ores of the country.

The policy of tariff on minerals should be based on the following principles:—

1. In the case of those metals and minerals which are of great national importance and are used in other subsidiary industries of which there is no stock in the country, they should be duty free so that the industries may be encouraged.

2. In the case of those essential metals which are of great national importance and of which there are ample resources in India, should be started in this country immediately with heavy protective duties.

3. In the case of important metals and mineral products for which there are big combines which will never like any other nation to rise, protection by tariff duties is necessary.

4. In the case of those metals and minerals which are of great importance for national defence, there must be high protective duties to encourage production of these in the country, as these are absolutely essential for the nation as in the case of alloys.

5. In the case of metals and minerals which are of great national importance, which must be conserved for the nation there must be heavy duty so as to discourage the export of those minerals.

6. In the case of metals like copper which are partly produced in the country and only meet a fraction of the national demand, and where the rest of the requirement comes from foreign countries after paying heavy duty, the result is that local companies get the benefit of those high duties to raise the prices of their products by that amount above the international prices. In this case an excise duty should

be charged as has been done in the case of salt, steel, etc. For the encouragement of other metal industries in India protective policy must be followed or if necessary bounties may be given in the beginning where the cost of production is high compared to international companies.

In the light of these principles a tariff list should be drawn up of the important minerals, metals and the export and import duties on them.

In the case of those finished goods which are imported at present from outside but which can be manufactured in the country out of the minerals available at present, side by side with the development of these industries there must be protection so that encouragement may be given for the consumption of Indian minerals. At present these minerals are very cheap but when they are converted into finished goods the price is increased several times.

A critical survey should be made of the Fiscal Commissioner's report as far as minerals are concerned, and in the case of the tariff policy on minerals.

XI. THE QUESTION OF LABOUR AND TRANSPORT.

Since the transport of minerals is a commercial business, it is essential that manufacturing operations should be as near the source of raw materials as possible. In order to work out the rates of transport, a Standing Committee, composed of representatives of the Industries Committee, Government Railway Authorities, and the present Committee, should review the source of raw materials, the site of consumption, and work out rates remunerative for the starting of basic industries. In the cases of basic industries like iron, coal etc., the question of providing adequate facility by the railways, roads and waterways, based upon a ten year plan should be properly considered. As regards road transport, the possibilities of charcoal lorries, wood lorries, etc., may be explored for Indian conditions. Besides these, in future provincial road building programmes, representatives of mineral industries should have a voice. In the development of minerals occurring in far off localities like the Himalayas, the question of aerial transport (rope-ways) etc. may be considered. For development of the metal industry in India, where transport plays an important part, an impartial tribunal should examine the cost of transport per ton per mile, and fix the rate of the principle that the railway is a public utility concern. The question of freight on coal should at the same time be critically examined in this relation, and the rates so fixed as to make it possible for the outlying provinces to re-

ceive adequate coal supplies to develop the industries. The State railways should play a part in this process.

XII. MINERAL CONSERVATION

The question of waste in the method of mining is a very important problem. During the last few years, the attention of the Government and the public has not been focussed on the waste in petroleum, metalliferous mines, and non-metalliferous mines like mica and it is desirable for national economy that the problem of waste in these lines should be critically examined by a sub-committee similar to the Coal Sub-Committee which may go in detail into the matter and recommend measures for eliminating it. For the conservation of the minerals it is essential that the greatest economy should be practised and efficient staff provided which can only be done by legislation.

XIII. MINERAL TAXATION

Although we are not in a position to give exact statistical information of the money recovered by the various Provincial Governments by way of royalty, rents and dead-rents for their mineral products and exploitation of the mineral right the rate is exceedingly low. For instance, in the Punjab the Government dues from the coal deposits of the Punjab amount to a negligible sum of Rs. 12,700 for an annual output of 4,400,000 gallons of crude petroleum. In the permanent settlement areas like the Provinces of Bihar and Bengal, where the amount of mineral production is very high the government royalties are insignificant, while the agricultural revenue is very great.

The whole question of mineral taxation in the different Provinces needs to be critically reviewed and revised and this Sub-Committee recommends the institution of this inquiry at an early date. The revenue that may arise from such a revised taxation scheme, will go a great way in financing the programme of mineral development, recommended here.

XIV. RULES AND REGULATIONS ABOUT MINING & PROSPECTING.

As regards the present rules and regulations for prospecting and mining leases, the Sub-Committee suggests their revision on the following lines, if necessary, by legislation.

1. For those for which leases are in force, or the prospecting licences have been given, the question of royalties should be very critically examined, and the rate revised in view of the existing conditions.

2. The companies holding these concessions should be compelled to train a large number of Indian technical per-

sonnel for future employment, and to employ them in the higher posts in a large measure.

3. Rigid inspection of the plants and working practices, especially in petroleum, coal and metal mines.

4. As regards new leases to be given in future, the Sub-Committee thinks that in the case of minerals, claims of Indian nationals should be considered paramount, in such cases where the State does not directly undertake the same.

(The mineral industry is a very important key industry and the policy followed for the key industries should be followed in this respect. Important mining concessions should not, as a rule, be given to non-Indians, on long term leases.)

5. In view of the fact that it is not possible for the small zamindars in the Permanent Settlement areas to develop the mineral deposits under their area, it is highly desirable that efforts should be made to acquire these underground mineral rights in these areas by the State for their exploitation, if necessary by legislation.

In view of the detailed nature of the comparative statistical work required, the Sub-Committee is of opinion that a special Sub-Committee be appointed to study the mining rules and regulations in different countries and to devise suitable rules and regulations for India.

XV. THE QUESTION OF FINANCE

The total finance invested in mining and metallurgical industries is roughly of the order of 30 crores of rupees which forms a considerable proportion of all the industries of India.

The finance needed for the development of the proposed new mining and metallurgical industries to satisfy the present industrial needs of the country (which amount to about 13 crores of rupees out of which some 10 crores worth can be manufactured indigenously) will be roughly 12.5 crores of rupees.

If machinery and armaments are to be included in the manufacturing programme, (whose imports amount to about 17 crores of rupees, the metal contents of which alone are worth about 10 crores,) this total might be augmented by another 12.5 crores. Thus, the total investment needed for carrying out the programme suggested here would be about 25 crores of rupees. The General Secretary may forward this matter to the Heavy Industries Committee.

This estimate is based on the present day import of machinery, to satisfy present day needs only. In view of the all-round development of industries in India, projected by the National Planning Committee, this figure is bound to be exceeded within the next ten years.

XVI. OWNERSHIP AND CONTROL OF MINERAL INDUSTRIES

Coal and petroleum are of vital importance to the nation. Hence they should be worked by the State either directly or through a commission on the lines of the Coal Commission of America. The present coal mines and the petroleum mines may be brought under the State ownership by payment of proper compensation.

2. If it is not possible to bring the existing mines under State control, at least for the future all the unworked coal and petroleum should be worked by the State as they are the key industries.

All the other minerals of less importance may be worked by private agencies.

3. All the important metals like iron and steel, copper and aluminium should be worked by the State as they are the key industries.

The key minerals like coal, petroleum, iron and steel, aluminium and copper may be worked by the Federal Government, while other smaller deposits may be worked by Provincial Governments. In case the Federal Government takes charge of the key minerals, the Provincial Governments in whose Provinces those minerals occur, should have a due share of the income arising out of it.

PETROLEUM

As petroleum is very important for the nation and as petroleum has already been monopolised by foreign companies, it is essential that whatever had been reserved, should be worked by the country itself.

(Future of the private ownership of petroleum is connected with other key minerals and should be discussed in connection with the coal and other minerals at further meetings.)

Due to the national importance of petroleum and its very limited resources, it is absolutely essential that some proper ways and means should be devised for proper inspection so as to avoid all wastage; and in the special Advisory Committee this should form a separate sub-section on account of its importance.

Looking to the importance of petroleum, it is essential that provision should be made in India for the proper training and high grade instruction in petroleum technology.

As foreign capital has mostly dominated the major mining and metallurgical industries it is essential that some way should be found to bring this capital under Indian control.

XVII. CONCLUSION.

As conditions in different Provinces are different, it is desirable that special attention should be paid to place the development of the mineral resources of the particular Provinces according to the needs and conditions prevailing there. The Sub-Committee is of opinion that it is a very detailed work, and that it be left over to the Department of Mineral Development of the Provinces as suggested. It is further suggested that meantime the Mineral Advisory Committee proposed to be set up immediately be asked to take the work in hand in co-operation with the Provincial Governments.

APPENDIX I

MEMORANDA SUBMITTED

By

J. J. GANDHY, B. SEN & P. N. MATHUR

The present production and future possibilities of development of metallic minerals and the ways and means for the realisation of these possibilities—ferrous only:

Ferrous minerals include not only Iron Ore but all alloying minerals such as

(1) Manganese Ore
(2) Chrome Ore
(3) Nickel Ore
(4) Cobalt Ore
(5) Vanadium Ore
(6) Tungsten Ore
(7) Molybdenum Ore
(8) Phosphatic minerals
(9) Silicon (Dioxide).
(10) Titanium minerals
(11) Beryllium (Beryl).

The figures of production of these minerals can be obtained from the Geological Survey of India. Details of the Tata Iron and Steel Company's consumption of raw materials for the five years, 1933-34 to 1937-38 together with the quantities despatched from its own mines, are given in Appendix 'A'.

The mineral resources of any country are, always a "wasting" asset and the magnitude of such "waste" in India can be realised from the total value of minerals produced, which for 1937 was as follows:—

	£	
Iron Ore ..	344,840	
Manganese Ore ..	3,229,554	
Chrome Ore ..	62,826	
Nickel-speiss ..	104,590	
Cobalt ..	—	(figure not available)
Vanadium ..	Nil.	
Tungsten Ore & concentrates ..	605,056	
Molybdenum Ore ..	—	do.
Phosphatic minerals ..	—	do.
Silicon ..	—	do.
Titanium minerals ..	84,686	

The above figures bring home to us the importance of exercising some control over production and of a proper utilisation of minerals in India. The above "waste" will be a true waste

from the Indian viewpoint if the minerals are allowed to be utilised for the benefit of other countries.

Iron Ore

At the present time Iron Ore is being extracted on a fairly large scale by three companies namely,

(i) The Tata Iron & Steel Co., Ltd.,
(ii) Messrs. Bird and Company,
(iii) The Indian Iron & Steel Company.

Messrs. Tata Iron & Steel Company and the Indian Iron and Steel Company utilise iron ore for their own consumption, namely, for the manufacture of Pig Iron and Steel; but Messrs. Bird and Company are selling part of their production to the Indian Iron and Steel Company and a part to Japan. Owing to the present political situation, however, the export of ore to Japan has been restricted. According to the estimate made by the Geological Survey of India about 3,000 million tons of iron ore are available in northern and Central India but the present production is only 3 million tons per year. There is, therefore, a very large scope for further production provided the ore can be properly utilised. The establishment of an Iron industry requires considerable capital and, in the earlier stages, foreign technical advice. After several vicissitudes, the iron industry in India appears to have come to stay and new entrants to this industry will not, therefore, have to face the same difficulties as were faced by the pioneers; but the successful development of iron ore for the manufacture of Pig Iron and Steel depends not only on capital but on an economical assemblage of various raw materials required for the metallurgy of iron and on the availability of a wide market. For instance, a site for the works must be within easy reach of iron ore deposits, coking coal, fluxes, water and a sea-port. Fortunately, for Bihar, iron ore and coal are located near each other and are also close to the port of Calcutta. Good flux, namely, limestone however is available at places far away from these deposits. The present industries depend for their supplies of flux on Gangpur State and the Central Provinces but this flux is not of very high grade. Enormous resources of high-grade limestone occur in Sylhet (Assam) and near Moulmein in Burma, but the distances are prohibitive. The limestone resources of Gangpur and the Central Provinces are, however, not inexhaustible and sooner or later, the existing industries will have to depend on dolomite, which is also available in Gangpur in large quantities, as the main fluxing agent in the metallurgy of iron. This may prove to be a more costly substitute in practice. Then again, the available resources of coking coal in India are limited and they

are not enough to smelt all the iron ore that is available in India. Beneficiation of the low-grade coking coal of Jheria or of the sulphur-bearing coking coal of Assam may be looked upon as a possible future solution of the difficulties of obtaining requisite supplies of the necessary metallurgical coal though it is not known at the present time whether beneficiation would be an economic possibility. It may be necessary to export part of our resources of iron ore in exchange for coking coal from other countries; but we are strongly of the opinion that iron ore should not be allowed to be exported from India for economic reasons. Due to the appalling poverty of the Indian masses and the acute conditions of unemployment amongst educated middle class, fresh avenues should be opened up for basic industries, specially iron industries which will not only absorb a part of the illiterate population but also educated people. Mere export of iron ore will not solve our problem. We should try not only to increase and meet all our internal demands, but also to sustain and expand export markets for our Pig Iron, and create foreign markets for steel, after the internal demand has been completely satisfied.

Japan is the principal buyer of our pig iron, or at least it used to be up to a little while ago. The international situation has created difficulties, so that until normal conditions are restored a clear conception of the future export trade in pig iron is not possible. Japan was also buying iron ore from the Keonjhar deposits in preference to pig iron, in order probably to keep their furnaces going. It also proposed to develop an iron ore field in Northern Australia, but this deposit is not likely to last long. It can therefore be assumed that Japan will have to depend on India for pig iron or iron ore.

There is again the possibility of exporting pig iron to the United States and the United Kingdom. Indian pig iron is cheap and pig iron landed c.i.f. in these countries may in the future compete with the local pig iron. When a proper understanding is reached between India and these countries, an expansion in the export trade of pig iron can be anticipated.

Manganese Ore

The value of Manganese ore produced in India is the highest amongst the metallic minerals but unfortunately only a small proportion of the Ore produced is actually consumed in India for the manufacture of ferro-manganese in the production of steel. Most of the ore is exported for the use of the European countries and of Japan and America. Manganese ore is an essential mineral for the manufacture of steel

and the State should apply a rigid control over its export. No estimate of the ore available in India is available at present and nobody can say if the Indian resources of manganese ore will be enough to convert all our iron ore into various forms of steel. If the export is allowed to go on unrestricted, India will surely be faced with a shortage of manganese ore for her own consumption. It is strongly recommended that the manganese ores of India should be thoroughly investigated and the resources available estimated.

Chrome Ore

The same remarks as above apply to chrome ore, but this is a matter of greater urgency. The present trend of the industry is for alloy steels and chrome ore is a very important ingredient from this standpoint. It is highly to be regretted that although the chrome ore deposits of India are known to be very limited, indiscriminate export trade has been allowed in the past. This should be completely stopped.

Nickel

Nickel, as known at present, occurs in workable quantities in Burma in the Silver Mines and the ore is exported as concentrates to Hamburg, Germany, for ferro-nickel. Attempts should be made in India to manufacture ferro-nickel as well as ferro-chrome for the production of rustless steel.

Cobalt and Vanadium

Very little is known about the occurrence of workable deposits of these minerals, but large deposits of Vanadiferous iron ore have been located both in Singhbhum and Mayurbhanj which have a potential value. Systematic research into the commercial possibilities of these deposits should be taken up.

Tungsten

Several Indian and Burmese occurrences are known but those of Burma require consideration. Ferro-tungsten is urgently required for war armaments and this mineral is therefore of considerable national interest.

Molybdenum Ore

Very little information is available as to the occurrence of this ore in India and the only occurrences that have been reported are of academic interest. In Burma it is found associated with tungsten ore.

Phosphatic minerals

Fairly large deposits of magnetite apatite ore are known to occur in Singhbhum, but unless basic steel can be made

in India at rates competitive with the Open Hearth Steel now being made, these deposits will remain only of potential interest.

Silicon (Dioxide)

Almost pure silica rock is available in India in many places not far from the existing iron ore industries and the question of making ferro-silicon should deserve the attention of the National Planning Committee.

Titanium minerals

Fairly large deposits of titaniferous iron ore are found in Singhbhum and Mayurbhanj, but ilmenite is not available in these deposits. The mineral occurs in Kishengarh State, Rajputana and in the beach sands of Travancore. Whatever ilmenite is produced in Travancore is chiefly exported for the manufacture of paints. The production of ferro-titanium in India is a question that may be considered but there appears to be no urgency in this matter.

Beryllium—(Beryl)

Beryllium is now coming into use for preparing special classes of alloys with special properties. In India it is found associated with mica-bearing pegmatite of Bihar and Nellore in Madras. It is also found in Ajmere.

II

A detailed investigation of raw materials for the existing industries as well as for industries which are essential to the country and will be developed later:

The following aspects are to be considered:—

A. Metallurgical and allied industries,

B. Refractories.

This subject covers wide ground and only a broad outline can be given in the present memorandum.

In order to make a detailed investigation of mineral raw materials, the staff of the Geological Survey of India should be considerably increased and their functions expanded. Separate provincial survey departments are not recommended, as they would not only impose a heavy burden on the finances of each Province, but would also unnecessarily duplicate the work of the Geological Survey of India, producing results that would perhaps not be commensurate with the expenditure incurred. The increased expenses of the Geological Survey of India may be borne by the different Provinces in proportion to the benefits expected.

Coming to specific investigation of raw materials the attention of the National Planning Committee is drawn to the following:—

(A) Metallurgical and allied industries

The existing metallurgical industries in India excluding Burma are:—

(a) Smelting of Iron,

(b) Smelting of Copper,

(c) Refining of gold.

The raw materials available for iron smelting have been partly indicated in the foregoing memorandum, where principally, the deposits occurring in Bihar and the Eastern States Agency have been considered. Large resources are also available in the C. P. such as in Drug, Chanda and also in Bastar (E.S.A.), Mysore, Goa and Ratnagiri. The Iron ore available in Bihar (Singhbhum district), Keonjhar (E.S.A.) and Mysore is being exploited, but the deposits in places other than these are still lying untouched. The occurrences at Drug, Chanda and Bastar are far from the existing railway routes. They are also far from the sources of coking coal. Dr. Crookshank has recently in a paper published by the Mining, Geological and Metallurgical Institute (Vol. No. 34, 1938) drawn attention to the possibilities of the Bastar

iron for export, but very large capital will be required if his suggestions are to be given effect to. Also, Mr. P. N. Mathur of the Tata Iron & Steel Company has recently put forward some suggestions that such ores as are located far from coking coal should be locally converted into sponge iron by means of charcoal. This is a matter that should receive the attention of the National Planning Committee. Mr. Mathur's paper on this subject has been published by the Mining, Geological and Metallurgical Institute in Volume No. 34, 1938, and is therefore available for reference.

The Mysore iron ore is being developed by the Mysore State, but the deposits at Goa and Ratnagiri still remain unworked. These are, however, partly in the Portuguese territories.

Copper

Copper is being smelted in the Indian Copper Corporation's plant at Ghatsila, but the resources of copper ore are not unlimited. The entire copper belt of Singhbhum should be thoroughly investigated.

Occurrences of Copper ore are also reported from Darjeeling district and Sikkim in Bengal and from Madras, Central India and Rajputana; but detailed information is lacking. A detailed investigation is necessary in this case as well.

Refining of Gold:—Gold is reported to occur in many places in India and washing for alluvial gold by primitive methods is carried out in many of the Indian rivers. The recovery, however, is extremely poor.

Vein gold is being worked in Mysore according to modern European methods and is being refined in the State. Prospecting for gold, however, has been fairly intensive in India and there is not much chance of finding important lodes.

As regards allied industries, the following deserve attention:—

(1) *Manganese Ore:*—Manufacture of ferro-manganese, chemicals and batteries:—

Ferro-manganese is now being manufactured by the Tata Iron & Steel Company for their own use in steel making, but with the growth and expansion of the iron industry in India further demand for ferro-manganese will arise. Those who are now exporting manganese ore should concentrate their attention on the manufacture of ferro-manganese at places close to coking coal and the manganese ore fields.

Batteries are already being manufactured in Jamshedpur and Calcutta, but this industry is capable of such further expansion, as India is taking more and more to motor traffic every year.

For the manufacture of chemicals and batteries, chemical grade ore is available in Bihar and the Eastern State Agency and in small quantities in the Central Provinces. Detailed investigation should be made as to the quantities available in these areas.

(2) Chrome Ore:—

The manufacture of ferro-chrome in India has already been briefly noticed in the previous memorandum.

In India, chrome ore occurs in Singhbhum district, Mysore and Baluchistan and the manufacture of ferro-chrome in all these 3 centres should be considered. The growth of this industry, however, will depend on the expansion of the steel industry and the manufacture of chrome-steel.

The manufacture of chrome chemicals, which are largely used for dyes, chrome-alum, tanning, paint, calico-printing and photography, should also be considered by the National Planning Committee.

(3) Nickel:—

Nickel is available only in small quantities in Singhbhum associated with copper ore, but the chief occurrence is in Burma. Detailed investigation should be made for the recovery of Nickel from the Copper tailings in Singhbhum for the manufacture of ferro-nickel for rustless and other special steels.

Nickel deposit is also reported from Travancore State but no detailed information is available.

The Nickel-speiss now made from the ore in Burma is exported to Hamburg, Germany, for further treatment. There is no reason why such treatment should not be undertaken in India.

(4) *Cobalt:—*

Occurrences of Cobalt have been reported from Rajputana, Travancore, Nepal and Burma. Only the Burmese occurrence is being exploited at the present time and the speiss obtained therefrom contains about 3|4 per cent cobalt. In the years 1927 to 1931, about 4|500 tons of the metal were exported.

Cobalt is used in many industries and is relatively rare in India. It is highly valued as an alloying material for steel owing to its magnetic permeability in electro-magnets. It is also used in high-speed steels, electro-plating, thermo-couples and acid-resisting receptacles, and in pigments for porcelain, earthenware and enamelling industries. If India is to undertake the manufacture of electric generators etc., the investigation of cobalt ores in India should be seriously taken up and all the known occurrences thoroughly studied.

(5) *Vanadium:—*

The occurrence of Vanadium in India has already been noticed in the previous memorandum. It is suggested that a detailed investigation should be made as to its commercial possibilities. Ferro-vanadium which contains about 30|40 per cent vanadium is a very important alloying material for steel as it imparts toughness and power of resistance to repeated shocks or varying stresses. Wrought steel containing vanadium has been used for piston rods, crank shafts, tyres, springs, cutter punch, die steel rock drills, saw edge tools, high speed tool steels, armour plates, gun shields, gun tubes, torpedo tubes, steel castings or locomotive frames, motor car and aeroplane parts. The manufacture of ferro-vanadium should therefore be considered not only from the point of view of essential industries but for defence purposes in times of war.

(6) *Tungsten ore and concentrates:—*

In times of war Tungsten is considered to be very valuable and to deprive a nation of tungsten is often to cripple its military power. It is used for armaments, high-speed tool steels and is also of great value in the manufacture of incandescent electric lamps. It occurs mainly in association with tin ore in Burma and after separation is exported. Indian occurrences are not very important, though mention may be made of the following localities:—

(1) Near Tatanagar Station, Singhbhum district,
(2) Agargaon, Nagpur district,
(3) Dighari, Marwar, Rajputana.

The Tatanagar deposit was explored during the last war but the results were very disappointing. As very little information is available about the other occurrences, these should be thoroughly investigated.

(7) *Molybdenum:—*

This is an equally useful material for alloying steels, the alloy being greatly in demand for forgings propeller shafts, armature plates and in automobile engineering. The Indian occurrences namely in Hazaribagh, Madras, Travancore and Rajputana have been found to be generally poor. The most important occurrence is in Burma in association with Wolfram and tin ore. It is reported that at these mines the proportion of Molybdenum has been found to increase in depth. The manufacture of ferro-molybdenum should be seriously considered by the National Planning Committee.

(8) *Phosphatic minerals:—*

The occurrence of phosphatic minerals in the Singhbhum district has been noticed in the previous memorandum. There

are two ways of using this mineral for ferrous metallurgy:—

(i) as an addition to the existing charge for the manufacture of pig iron so as to increase the percentage of phosphorous for the ultimate manufacture of basic (Bessemer) steel;

(ii) for the manufacture of ferro-phosphorous for foundry use.

The deposits do not appear to be sufficiently large for Bessemer steel making, but the entire reserves have not been estimated. The manufacture of ferro-phosphates may, however, be considered. The present demand is not large but there is a possibility of expansion in its use.

(9) *Silicon:*—

The possibility of manufacturing ferro-silicon from the existing deposits has already been briefly indicated. It is suggested that the occurrences near Rajgir be thoroughly investigated.

The consumption of ferro-silicon is at present small, but with the expansion of the steel industries the demand for it will increase, so that the manufacture of ferro-silicon is worthy of consideration by the National Planning Committee.

(10) *Titanium minerals:*—

The above suggestions apply to titanium minerals also. Titanium minerals occur in Kishengarh, Rajputana and Travancore. Large deposits of titaniferous magnetite occur in Mayurbhanj State and Singhbhum district; but the percentage of titanium varies between 5 to 15 per cent. This is too poor for the manufacture of ferro-titanium. Ferro-titanium is valued for its non-corrosive properties and forms an alloy with nickel and cobalt.

(11) *Beryllium:*—

It forms alloys with copper, nickel and iron, beryllium-iron alloy being of recent origin. It is specially used for the vital parts of aeroplane engines and 80% ferro-beryllium is used for cementing steel. Wider use of the beryllium alloy should be investigated and the Indian occurrences thoroughly studied. In mica mining the mineral Beryl (containing beryllium) is now thrown into waste dumps; arrangement should be made for its recovery. A brief indication of the Indian occurrences of this mineral has already been given in the previous memorandum.

(12) *Bauxite:*—

The possibility of the manufacture of aluminium from Indian Bauxite has been engaging the attention of various industrialists, since the publication of the Survey of India report on the bauxite occurrences of India but the matter took

no concrete shape until recently. The main difficulty about the manufacture was attributed to want of cheap electrical power and the dependence on foreign countries for supplies of cryolite, which is considered to be a catalytic agent in the manufacturing process. A company has recently been formed with American and Indian capital and it will start manufacturing aluminium close to the coal fields in the near future. The necessary power will be generated by steam.

India imports aluminium sheets and wares in large quantities and it is to be regretted that the manufacture of aluminium in India was not taken up earlier. Aluminium alloys now take a very wide place in modern airships and aeroplanes and they have a variety of other uses in the building of railway coaches, motor cars and steamers.

India is very rich in bauxite, its main occurrences being in the districts of Ranchi, Jubbulpore and Belgaum. Occurrences have also been reported from Kalahandi State, Kashmere, Sarguja, Jaspur and Balaghat etc. For detailed information reference may be made to the Memoirs published by the Geological Survey of India on the subject.

(13) *Coke and Sulphuric acid:—*

The importance of coke of metallurgical grade can never be minimised in a scheme for the development of metallurgical industries. There are, however, several bye-product plants now working in India.

For the recovery of a bye-product like ammonia in coke-making, sulphuric acid is indispensable. In India, at present, all sulphuric acid is manufactured from imported sulphur. As is well-known this acid is the key to many chemical industries and the finding of raw material for it in India is a matter that calls for the urgent attention of the National Planning Committee.

Sulphur is present in some coals (Assam) some pyritous shales, and its recovery from the smelting of copper ores at Maubhandar and the lead-zinc ores at Namtu has been strongly advocated from time to time. Recently an occurrence of Iron Pyrites has been reported from Keonthal State near Simla.

(14) Indication has been given in this memorandum of the metallurgical industries now in existence in India, but if this country were to be self-sufficient, attention should also be given to the establishment of the following metallurgical industries:—

(a) Smelting of Lead,
(b) Smelting of Zinc.

Smelting of Lead:—

Lead smelting is now being carried out in Burma by the Burma Corporation and the reserves of this ore at the Bawdwin Mines are estimated to be about four million tons. Very little information is available about the Indian occurrences of lead ore (Galena) but deposits are reported to occur in Jaipur State, Udaipur State and Khairagarh State, and also at Kathouria, in Bhagalpur district. The Indian occurrences should be fully investigated and the reserves estimated, as India consumes large quantities of lead every year and about 145,000 tons of pig lead valued at 28½ lacs of rupees were imported into this country from Burma in 1937.

Smelting of Zinc:—

Ancient zinc mines are reported to occur in Udaipur State, Rajputana, but no trace of the zinc bearing mineral can be found on the surface. In Kashmere there are occurrences of zinc ore in Riasi district, which the Tata Iron & Steel Company investigated a few years ago. The quantity available does not appear to be large. There is no difficulty in generating hydro-electric power near the occurrences. Zinc ore concentrates are produced in large quantities by the Burma Corporation Limited from its Milling plant at Namtu, and are annually shipped to Belgium and Germany. There was a proposal to smelt Burmese zinc concentrates at Jamshedpur but the scheme has not yet materialised. As India consumes large quantities of zinc for galvanised sheets, brass and other alloys, smelting of zinc in India needs investigation.

(B) Refractories

The systematic study of refractories is of relatively recent date and as a result of intensive investigation various minerals and their products are now put to use as refractories. They may be classified as follows:—

(1) Basic refractories:—

(a) Magnesite,
(b) Dolomite,
(c) Dunite and Forsterite,
(d) Bauxite,
(e) Chrome-magnesite,
(f) Spinels,
(g) Steatite.

(2) Acid refractories:—

(a) Silica rock or ganister,
(b) Quartz mica schist and quartz kyanite schist,
(c) Kaolinous sandstone,
(d) Kyanite, Sillimanite and Andalusite,
(e) Fireclay, China clay
(f) Bentonite.

(3) Neutral refractories:—

(a) Chromite,
(b) Graphite,
(c) Zircon
(d) Asbestos.

We shall consider the above in the order described.

(1) Basic Refractories:—

(a) Magnesite:—

Magnesite is a very good refractory, if dead-burnt to a temperature of about 1,600 to 1,650°C. The dead-burnt product is moulded into bricks which are used in the construction of steel furnaces. It is not affected by the molten metal and slag. Magnesite is a carbonate of Magnesium, and in India it is found in abundant quantities in Salem District, Madras and in Kadakola, Mysore. Both these deposits are being exploited, the former by the Salem Mining Syndicate and the latter by the Tata Iron and Steel Company, Limited. Dead-burnt magnesite is also used in pea size for the hearth of steel furnaces. The consumption of Magnesite in India at the present time is small and the Tata Iron & Steel Company is the only major consumer. With the advent of other companies, the consumption will increase. Fortunately, the Indian reserves are enough to meet future demands.

(b) Dolomite:—

Dolomite, when dead-burnt to a temperature of 1600 to 1650° C yields a good refractory, but it is not valued as highly as the dead-burnt Magnesite. This is due to the fact that dolomite is a double carbonate of Magnesium and Calcium and after dead-burning, the Calcium oxide gets slaked in moist atmosphere.

If used immediately after dead-burning it can replace dead-burnt magnesite for repairing open hearth bottoms. Dolomite bricks are also being used in many places in Europe as refractory brick in the construction of steel furnaces, these bricks being used in the hot gas line.

Dolomite brick has not come into use in India as yet but this is a matter that should receive the consideration of steel makers. In India good dolomite is available in large quantities, but those occurring in Gangpur State, Eastern States Agency, are the purest. The Tata Iron & Steel Company obtains its supply of refractory dolomite from the Gangpur deposits.

A large amount of Carbon-di-oxide is let loose into the atmosphere in making dead-burnt magnesite and dolomite. It should be considered by the National Planning Committee

whether such gas should not be recovered for the purpose of manufacturing dry ice. As it is too much to expect that the manufacturers of basic refractories should take upon themselves the manufacture of this ice this work should be left to subsidiary companies. The recovery of Carbon-di-oxide from lime kilns should also receive attention.

(c) Dunite & Forsterite:—

Dunite is essentially Magnesium-Iron Silicate and is a natural rock that can be had in large quantities in India especially in association with chrome ore. Experiments are being made in many places as to its suitability for use as a refractory lining in special type of furnaces.

The mineral Forsterite is a constituent of Dunite but it is also developed at high temperatures in rocks rich in Magnesium and Silicon. Forsterite bond adds strength to basic refractory bricks and is valued on that account.

Investigation should be made as to the commercial possibility of Indian Dunites as a refractory material.

(d) Bauxite:—

Bauxite, as already indicated in this memorandum, is available in very large quantities in India. At the present time bauxite bricks are not manufactured in India, although the ore is occasionally mixed in small proportion in the manufacture of certain type of refractories. Bauxite is also used in the manufacture of certain types of cement.

(e) Chrome-magnesite:—

A combination of chrome and magnesite has been found to be very suitable for the manufacture of chrome-magnesite bricks for use in the construction of steel furnaces. It is widely used in America and Europe. Chrome-magnesite bricks have generally the following composition:—

MgO	22.78%
Cr_2O_3	43.14
SiO_2	9.10
Al_2O_3	8.10
Ferric oxide	15.44

Chrome-magnesite brick is finding increasing use in the construction of basic steel furnaces replacing silica brick.

(f) Spinels:—

Magnesium spinel (MgO, Al_2O_3 is coming into use as a refractory and it is said that it has a melting point of over 1800° C. Magnesium spinel is found in Burma and it is not known if it occurs in India in commercial quantities.

(g) Steatite:—

Soapstone has been found to be suitable as a refractory but its use in India is almost nil. Large deposits are available and proper investigation should be made.

Pure steatite is available in Rajputana and in less pure form in Singhbhum district, Bihar.

(2) Acid Refractories:—

(a) Silica rock or ganister:—

Silica rock or ganister of suitable composition is available in large quantities in many places in India but is chiefly found in the coal measures of Bengal and Bihar and in the metamorphic rocks in Bihar, especially near Rajgir and Ghatsila. This rock is the principal source of material for silica brick and silica cement. Two firms are now manufacturing silica brick near Raniganj and Jheria and their products are consumed in very large quantities in the Tata Iron & Steel Company's plant at Jamshedpur. There is no dearth of this material within easy reach of the coal fields and India should be able to take care of any increased demand in future.

Silica cement can also be made from crushed silica rock and it is used in considerable quantities as a refractory mortar. It is, however, necessary to mix suitable clays or other products with it to impart to it the plasticity required.

Silica bricks are considerably in use in the construction of modern coke ovens and are also used in the construction of Open Hearth Steel Furnaces.

(b) Quartz mica schist and quartz Kyanite schist:—

Quartz mica schist and quartz kyanite schist are available in many places in India but at present the chief source of supply is from a deposit near Ghatsila. This rock is used as an acid lining for steel converters in the Duplex process of steel making at Jamshedpur.

The rock generally contains about 85% silica and should be very low in iron and alkalies in order to withstand a temperature of over 1400° C. The proportion of mica in the rock should be low but a small presence of it is helpful in trimming the rock to the desired shape.

The quartz Kyanite schist is also very similar to this rock and is used for the same purpose.

(c) Kaolinous sandstone:—

Kaolinous sandstone is gradually coming into use as a lining for acid furnaces and in America a similar rock goes by the name of Firestone. Experiments are being carried out in the Tata Iron & Steel Company's Works at Jamshedpur for the use of felspathic sandstone as a lining for acid con-

verter. It is too early to say if wide application of this rock can be found for refractory purposes. The material should be low in iron and alkalies.

(d) Kyanite, Sillimanite and Andalusite:—

Kyanite, Sillimanite and Andalusite as refractory materials on a commercial scale came into prominence after the discovery of deposits of sillimanite in Assam and of kyanite in Kharsawan State. The massive compact rock is the one generally used for refratcory purposes. These three minerals have the same chemical composition Al_2O_3, SiO_2 and on heating to high tempratures namely from 1100 to 1550° C depending on the mineral concerned, they change to Mullite (3 Al_2O_3, 2 SiO_2). Mullite can stand a temperature up to 1800° C without melting and it is considered to be a high class refractory which possesses many beneficial properties.

Kyanite being more easily available than Sillimanite or Andalusite, is principally used for the manufacture of kyanite bricks, it being first heated to a temperature over 1500° C and then crushed and moulded into bricks with some suitable bond. Owing to the high cost of making the bricks, their use is much restricted. Research work in kyanite refractories is being conducted in many places including the Tata's Works at Jamshedpur.

As there are considerable deposits of Kyanite in India there will be no difficulty in meeting future demands. Kyanite bricks are extremely suitable in the construction of furnaces for glass making and other ceramic products. They have not come into wide use in the iron industries because they are badly affected by Iron oxides.

(e) Fireclay, China clay:—

(i) Fireclay:—

The name 'Fireclay' is practically applied to all clays which can stand a high temperature and these clays are found to be widely distributed in the coal measures of India. Of the fireclays those that are plastic are highly valued. Fireclay should contain approximately 45|50% SIO_2 about 35% AI_2O_3 and low alkalies. Iron should also be very low. Fireclays are now being worked in many places in the coal fields and Tatas hold large deposits near Belpahar in the Ib coal measures. In India high alumina fireclay is rather rare and if a clay with 40% alumina could be found it may prove to be extremely valuable. Firebricks are made from fireclays and there are several companies in India which have suitable plants for making firebricks. Large quantities are consumed annually by the steel, sugar and cement industries. Indian made firebricks have proved equal in strength and durability to the best obtainable in any other country.

(ii) China clay:—

China clay, if pure, should have a melting point of about 1800° C but pure China clay is difficult to get. The material has to be thoroughly washed before it can be used as a refractory. However its use as a refractory is very limited. China clay should contain about 40 per cent Al_2O_3 and about 50% SiO_2 with varying alkalies and iron. In India several occurrences are known and those in Raj Mahal hills are now in use in the Bengal Potteries Ltd., Calcutta. Abundant deposits are also found in Singhbhum district and are being exploited by various firms. There is a very wide scope in India for the manufacture of various clay products and this should receive the attention of the National Planning Committee.

A variety of sanitary wares are now manufactured by Messrs. Burn & Company, Raniganj. The Bengal Potteries Limited, Calcutta, manufacture China wares and Mysore Government has also recently started a factory at Bangalore for the manufacture of China wares and insulators. Careful investigation should be made to improve the Indian products so as to replace the Japanese and other imported goods that are being dumped in the Indian markets.

(f) Bentonite:—

Occurrences of Bentonite have been reported from Rajputana and Kashmere and experiments have been made in the Tata Iron & Steel Company's Works at Jamshedpur for its use as a refractory bond. The deposits require further investigation.

(3) Neutral Refractories:—

(a) Chromite:—

We have already discussed the occurrence of Chromite earlier in this memorandum. Chromite, as a neutral refractory, is of considerable use in the steel furnaces where it is used either in the form of powder or in the shape of bricks to form a neutral layer between the magnesite and silica or firebricks. Chrome bricks are now being manufactured at Raniganj and Jamshedpur for the iron and steel industry.

(b) Graphite:—

This is used for the manufacture of refractory crucibles. The principal producers of this mineral are Ceylon and Travancore but occurrences are also reported from Kalahandi and Patna States in the Eastern States Agency. It is also found near Rajahmundry where it is being mined by a local firm and made into crucibles. Graphite, rather impure, also occurs in Palamau district. Graphitic shale is found in Ranchi and Singhbhum districts and it requiries beneficiation before it can be used.

(c) Zircon:—

This is considered to be a very good refractory with a melting point of about 2200° C. Zircon sand is available in Travancore and is now exported.

(d) Asbestos:—

Asbestos has fire and acid resisting properties and has therefore a variety of uses. Mixed with cement and other substances it can be used for the manufacture of tiles, sheets and fireproof coverings. The Indian asbestos belongs to the Amphibole variety and its fibres are rather brittle although they can be had occasionally in good lengths. It occurs in several places e.g. Seraikella, Mysore, Bhandara (C.P.), Idar State, Bombay, Ajmere-Merwara, Rajputana and Cuddapah, Madras; but further prospecting is required to locate deposits of chrysotite asbestos which is considered to be superior to the Amphibole type.

Large quantities of asbestos goods are imported into India and it is to be regretted that hardly any attention has been paid to the Indian occurrences for meeting the internal demands. It is not difficult to manufacture asbestos goods and there is no reason why such goods should not be manufactured in India.

III.

TRAINING MEN FOR MINERAL INDUSTRIES.

The development of the mineral industries of a country may be considered in three stages: the first is an economic survey of the entire mineral resources, the second, their mining or extraction and the third and last their disposal. The last one does not fall within the purview of this memorandum involving as it does questions of finance and commercial organisation and, therefore, need not be considered.

2. PERSONNEL:—

As regards the personnel required to be trained to develop the numerous industries, the following categories may be considered :

(1) Geologists and Prospectors
(2) Mine Managers (both coal and metal)
(3) Mine Surveyors
(4) Chemists and Research Workers
(5) Craftsmen.

3. TRAINING:—

(1 & 2) Geologists, Prospectors and Mine Managers

(i) *Theoretical Training*:—The training should be of 4 years' duration and be directed to the grounding of the students in the principles and methods of geology and mining, both in theory and practice. During the first 2 years the courses of study, which should include both lectures and laboratory practice, should be common to all. Specialisation in the different branches, such as Geology, Coal Mining and Metal Mining, may, however, be permitted from the third year of training.

A Geological and Mining Institute should be established for the purpose of training. It should have a well-qualified staff and well-equipped laboratories for students' use and research. So far as Bihar and the United Provinces are concerned, geology and mining are already being taught in the Indian School of Mines, Dhanbad, and the Mining & Metallurgy Department of the Benares Hindu University. These two institutions should be able to meet the requirements of the mineral industries in their early stage of development. They should, however, pay more attention to metal mining than hitherto. Similar institutions may be established in other provinces according to their requirements and

having due regard to the nature and growth of the mineral industries in the province.

Several Universities in India also offer geology as one of the subjects for graduate and post-graduate study. It is suggested that the Universities may discontinue their post-graduate study in geology except for the purpose of research and that the students after graduation should spend two years in a Geological and Mining Institute where their training in geology will be more practical than academical.

(ii) *Entrance Qualifications:*—Candidates should have passed at least the Inter Science Examination of an Indian University with Physics, Chemistry and Mathematics or its equivalent, and should preferably be not more than 19 years of age at the time of admission.

(iii) *Selection:*—The selection of students at the time of admission should be made very carefully. The life of a prospector or a mining engineer is a hard one and only those students should be selected who are physically and mentally equipped to succeed in the profession. Application of psychological methods of selection may be considered in this connection.

The number of admissions should be strictly regulated according to the progress of the industries and their capacity to absorb trained men.

(iv) *Practical Training:*—Technical education is not complete without practical training. There should, therefore, be a close integration of the work of the Institute with the practical training of the students, and it should be made compulsory for every student to spend at least two months in the year during their training on field work or in a Mine or a Colliery. This training should be supplemented by a year's further training at the conclusion of the course.

3. Mine Surveyors

The Mine Surveying Course normally forms a part of the Geology or Mining Course and is to be taken by all students. Individuals who are already employed in the mineral industry but who do not like to take the full course in geology or mining, may be permitted to take this course as part-time students in order to qualify for the Mine Surveyors Certificate after they have acquired the requisite amount of practical experience.

4. Chemists

No special training is required. B.Scs., and M.Scs. of Indian Universities in applied Chemistry should find no difficulty in filling up these posts.

Research Workers

Students who have creditably completed the Diploma Course in geology or mining and who possess the necessary ability, should be encouraged to undertake research work at the Institute laboratories or at the Central Institute of Geology & Mining, which will be mentioned later. In addition, facilities for research should also be granted to a limited number of pure Science Graduates with brilliant academic record. They should carry out research on some problems in Geology or Mining or Science as applied to the mineral industries and should be paid a subsistence allowance while they are so engaged.

5. *Craftsmen*

The training should be essentially practical and of a specialised character. For this purpose a Trade School should be established in a central position. The following is a list of Trade Courses which may be offered by the School. The list is by no means exhaustive:—

(1) Fitting
(2) Turning
(3) Tool making
(4) Drilling (core)
(5) Armature Winding
(6) Electrical Wiring
(7) Electrical Technology for Switch-board and Power House Attendants
(8) Welding
(9) Automobile Repairs
(10) Pattern Making
(11) Carpentry
(12) Moulding
(13) Boilers and Steam Engines, etc., etc.

Each student should be given a choice of trade at the time of his admission and should specialise in the trade he has selected. The period of training should be 4 years.

The School should have a well-equipped workshop and work should be carried out on a time and cost basis as far as possible.

In addition to the practical training, the students should also be given a certain amount of theoretical training in the following subjects:—

(1) Hindusthani Composition
(2) Arithmetic
(3) Geometry
(4) Elementary Science

(5) Workshop Practice
(6) Engineering Drawing.

The students should have passed at least the Upper Primary Examination and should preferably be between the ages of 14 and 17 years.

4. DIPLOMA:—

Geological & Mining Institute:—

Students who satisfactorily complete the Institute Course in Geology or Mining may be given a Diploma showing their attainments in the subject in which they have specialised. No student should, however, be given this Diploma until he has satisfactorily completed the requisite amount of practical training.

Trade School:—

Students who have satisfactorily completed the School Course and passed a trade test may be given a certificate showing the trade in which they have specialised. The trade test should be conducted by an independent Board of Examiners.

5. ADMINISTRATION:—

The Geological & Mining Institute as well as the Trade School may each be administered by a Council consisting of Government officials, eminent geologists, mining engineers and scientists, representatives of employers and the teaching staff.

There should also be an independent Board of Inspectors to inspect the work of the Institute and the School.

CENTRAL INSTITUTE.

For post-graduate and research work there should be a Central Institute of mineral technology and this will deal with questions of all India importance. The work carried on in this institute should be co-ordinated with the work carried out by the other universities either in geology, mining or metallurgy. This institute should admit selected candidates from the various universities who have secured degrees either in geology, mining or metallurgy.

The functions of this research institute should be as follows:—

(1) Post-graduate and advanced study,—mainly economic,
(2) Undertaking of research work on behalf of the mineral industries e.g. marketing of ores, investigation of minerals with a view to finding out its commercial utility, studying and helping the needs

of mineral industries and helping to set up key industries both mining and metallurgical.

This research institute should be able to supply thoroughly trained and tried men who can ultimately take up important positions in the various industries.

This institute should have highly technical men as Professors and up to date laboratories should be provided. Provision should also be made for research stipends to enable suitable candidates from other universities to prosecute research.

This institute should be under the control of a governing body consisting of Government heads of scientific and technical departments, non-officials connected in mineral and metallurgical industries, and representatives from universities. The governing body should be an independent body unfettered by Government control and should preferably be a statutory body.

All problems relating to mineral industry should come up for the consideration of this body and it should also act as mineral adviser to provincial and federal governments. This will ensure co-ordination of work between the various provinces and the attainment of the aims and objects of the National Planning Committee.

The Governing body should also be required to take note of the natural resources of the country, their merits, their wants and by a careful adjustment of various factors it should try to aim at the maximum state of self-sufficiency that can be attained. Such study may be subject to periodic review and if necessary, modification, but the aim should be to keep pace with the modern requirements of a civilised community. Most of the heavy industries depend on minerals and as India is fairly well endowed with most of the essential minerals for industrial self-sufficiency, the usefulness of a Central Institute cannot be overstressed.

The Central Institute should preferably be located in Calcutta in order that it can remain directly in touch with the industries, museums, government statistical departments and the Geological survey. It should also arrange for a quarterly technical journal to be published giving an outline of the advance made in India in the branches of Geology, Mining and Metallurgy, and special contributions may also be invited from men engaged in mineral and metallurgical research.

Representatives of this institute should find a place on the All-India commission that will be set up by the National Planning Committee.

IV

BENEFICIATION OF ORES.

The word "Beneficiation" is of comparatively recent introduction and of somewhat doubtful limitations. The older terms "dressing" and "milling" of ores serve quite well to connote processes for the removal of adhering gangue or waste material of a type different from the ore itself. "Beneficiation" seems to imply some improvement in richness of the mineral treated but it must consist, as a rule, in removing non-essential matter to leave a richer residue, just as in "milling" and "dressing." It is true that in "beneficiating" an iron ore there may in some cases be a reduction from the ferric to the ferrous state with a consequent slight increase in iron content, and similar reduction enrichment may occur in the beneficiation of manganese ores but this is not an essential feature of beneficiation.

Presumably almost any process that takes a low grade ore and converts it into a higher grade ore is a beneficiation process though this would include milling and dressing, which do not affect the chemical constitution of the individual grains of ore, and roasting of carbonates which does affect the chemical composition, but leaves the mineral still as an ore, though roasting is really part of the metallurgical process for extracting the metal.

However, many words that are difficult to define exactly are none the less useful and well-understood; and we can have a fairly clear idea of what we mean by "beneficiation" without more discussion of its exact meaning.

In this discussion we also propose to consider other improvements in ores, fluxes and fuels, prior to smelting, such as sizing, sintering, briquetting and nodulising.

Beneficiation of Iron Ore:

India's huge deposits of high grade iron ores make any consideration of beneficiating the lower grade iron ores of academic interest only, as far as iron content is concerned. But there are very large quantities of high grade ores in a very fine state of division occurring intermixed with the harder iron ores, and these fine-grained ores cannot be used in present-day Blast Furnaces without special treatment. The "blue dust" ores of the Singhbhum-Orissa field are such fine powders that sometimes as much as 40% will pass through a 200 mesh screen. Their iron content varies from 63 to 68%. They could be sintered or briquetted in a suitable plant to

make them suitable for smelting; but the cost of sintering would probably be greater than the cost of mining the harder ores which do not require to be sintered.

Sintered ores, however, usually give better results in the Blast Furnace than natural ores, on account of their spongy condition, which facilitates smelting. Whether any such improvement could be sufficiently marked to offset the high cost of sintering, bearing in mind the cheapness of the Indian harder ores delivered at the smelting plants, is a point that could only be settled by large scale and costly experimental tests. Laboratory experiments are of no value, and this problem must remain undecided until one of the smelting companies decides that the experiment is worth making. Economic changes such as an increase in the cost of mining the harder ores, or say an increase in the proportion of powdery to hard ores found in the development of the ore bodies now being worked, might make such experiments worthwhile, possibly in the near future.

Coal:

India's supplies of coking coal are as notoriously low as her iron ores are abundant and not only are the quantities low in proportion to the ore reserves, but the quality is also poor. Still worse, the Indian coking coals present special difficulties in treatment for reducing ash content, so that whereas coking coals in Europe and America often contain below 10% ash as mined and can be easily cleaned to reduce the ash to say 3 to 5%, India's coking coals contain from 12 to 20% ash or more and up to date little success has attended efforts at reducing the ash content by cleaning. The main reason for this difference is that the "ash" in most European and American coals consists mainly of pieces of plain shale, almost free from carbonaceous matter, derived from the roof or floor of the seam, due to driving with coal cutting machines just outside the seam limits in order to get the whole of the seam without wastage. In addition some shaly matter is obtained from intermediate bands of shale within the coal seams.

Such pure shaly matter has a specific gravity different from that of the coal and is mainly in pieces over 1|4 inch in diameter. It can easily be separated by wet or dry methods of cleaning at a low cost and without wasting any serious quantity of coaly matter in the process.

In the Indian coking coals however, whilst a little of the ashy matter may be of the type above mentioned (which may be called "extraneous" ash) the bulk of the ash is in a finely

divided condition and is intimately mixed with the coal itself. This "inherent" ash presents a difficult problem for any coal cleaning process.

Coal cleaning processes are of three main types:

(a) Processes utilising currents of air or water against which heavier particles fall more readily than lighter. For these methods there must be some preliminary sizing of the material by screening. If for example we are separating coal of lower S.G. from shale of higher S.G. the shale will fall below the coal and the two layers can be separated, but if large equidimensional lumps of coal are mixed with small flat pieces of shale the latter will be carried by the current and mixed with the coal, and the large pieces of coal will overcome the current and mix with the shale.

Provided however the material is screened before treatment so that there is no great range in particle size these methods are efficient. They include such processes as the Rheolaveur and Baum washing systems.

(b) Processes utilising "heavy liquids" with no appreciable current action. Obviously if we can get a liquid whose specific gravity is midway between those of the coal and the shale to be separated the one will float and the other sink and the two can be taken out separately.

True heavy liquids are as a rule too costly for large scale use though they are used in laboratory tests. Instead in commercial practice mixtures of water with such materials as fine sand, finely ground Magnetite and Pyrites and other minerals are used. A slow moving current of water keeps the sand grains in suspension and maintains a uniform density that causes the lighter coal to float on the mixture and allows the heavier shale to fall to the bottom of the separating trough. The water current mentioned is too sluggish to affect the separation. Particles of all sizes are equally well separated by this process, down to small pieces of say 3|16 inch. It is obvious however that really fine material, of the same size as the sand grains used to make the heavy liquid, cannot be separated, as they would tend to mix with the sand and alter the density of the "heavy liquid."

Amongst the processes of this type that are successfully operated are the "Chance" process, using sand, and the "Tromp" process using magnetite or pyrites.

(c) Methods of flotation. The flotation process depends on the fact that certain minerals in a fine state of division are not wetted by water. By adding a small proportion of oil to the mixture of finely divided coal, shale, and water, and agitating it, we get a multitude of fine bubbles formed which

attach themselves to the dry coal powder but not to the wet shale powder. The air bubbles carry up the coal to the surface as a light oily froth which can be continuously floated off, and dried into a cake suitable for coke manufacture whilst the shaly matter sinks and is carried away as a sludge.

Of the three types of beneficiation above mentioned, the first two are suitable only for the removal of particles of "ash" material over say 3|16 inch diameter. This is mainly extraneous ash such as shale particles but might also include mixed coal and shaly pieces commonly known as "middlings." It is possible to separate a coal by these processes into three products—cleaned coal, middlings and waste. The middlings, if not saleable as such, may either be used as fuel for the colliery boilers or may be crushed and given further cleaning.

Indian coking coals of the higher ash grades may contain, in addition to the finely divided inherent ash, a fair proportion of extraneous shaly matter that can be removed without resorting to flotation. Certain coals containing 20 to 25% ash may, by removing extraneous ash, be improved to say 15 or 16% ash coals, and such treatment may perhaps bring very considerable quantities of coal, not now considered as suitable for the manufacture of metallurgical coke, into that category. Indian coal companies are well aware of this possibility and many tests have been made in recent years, with encouraging results.

When we come to the task of removing a fair amount of the "inherent" ash, and cutting the ash percentage down from say about 15% to below 10% we are faced with a more formidable problem.

About the year 1923 Mr. W. Randall of the Minerals Separation Company made cleaning tests by the flotation method on a very large number of Indian Coking and other coals and the results of his work were published by the Geological Survey of India.* He established the fact that these coals with 20% ash or less could quite well be cleaned by the flotation process, but unfortunately at a cost that at that time was uneconomic. The main reasons for the high cost were—

(a) In order to get a fair separation of the coal and the ashy material it was necessary to grind down to a fineness of at least 80 mesh.

(b) Even then the coals were not separated into pure coal and pure shaly matter. They were only separated into purer and less pure coals. As a typical example a sample

* Records G. S. I. Vol. LVI—1926—Pp. 220-249.

of Jharia 13 seam containing 20.1% ash could be washed to give 80% of the original weight with 13.9% ash and the balance 20% with 45.0% ash, or as an alternative it could be split up into 60% by weight with 11.9% ash and 40% by weight with 32.4% ash. Intermediate results could also be obtained. The waste portions of the coal were themselves so high in coal content that they constituted a serious wastage of combustible material. Yet they were too high in ash to be used as fuels except locally for boiler uses and the quantities would be too great for that purpose only. Consequently no firm has installed any plant for cleaning Indian Coal by the flotation process up to date.

The possibility of a combination of two washing processes may also be considered. The coarser sized coals might be washed by some such process as the Chance or Tromp method. In the course of handling the coal, any fines produced might be treated by the flotation process. Such methods are being used in Europe and America with satisfactory results.

Manganese

It might be considered that India has such large quantities of high grade manganese ores that beneficiation would not be economically possible, but this is far from correct. The largest deposits of high grade ores are in the Central Provinces, at a considerable distance from the sites selected by the Iron & Steel Companies for the Blast Furnaces which can utilise these ores. Comparatively small deposits of high grade Manganese ores occur in the Orissa States of Keonjhar and Bonai. These deposits are much nearer the iron works than are those of the Central Provinces, and if some means of separating the iron ore from the manganese can be devised the value of these deposits will be greatly enhanced. If the iron ores were magnetic the problem would be simple, but they are hematites. There is here a fruitful field for research work. Recent work based on the reduction of the hematite to magnetite, with magnetic separation of the finely ground ore, has given encouraging results.

Fluxes

India's deposits of Limestone and Dolomite are sufficiently pure not to need any beneficiation. Fluorspar has only recently been discovered in quantities suitable for economic exploitation. In these deposits the fluorspar is intimately mixed with quartz, and some system of crushing and jig-washing will be desirable to render the fluorspar sufficiently pure for use as a flux.

Refractories

Magnesite occurs in large deposits in Salem and Mysore, sufficiently pure to need no treatment beyond ordinary hand dressing.

Chromite also occurs of good grade in Baluchistan and Southern India. The deposits nearest to the Iron & Steel Plants however include considerable quantities of low grade ore that can be very much improved by crushing and concentration. Such methods, of a very crude type, have been adopted successfully in recent years in the Singhbhum District.

Alloy Minerals

Chrome is also valuable as an alloy mineral and concentrates produced by washing the Singhbhum Chromite would be quite suitable for such use.

Vanadium occurs in the Titaniferous Magnetites of Mayurbhanj State. Its distribution is very capricious, but it is possible that careful research work might reveal some means of isolating the vanadium-containing constituent. If so a very valuable ore would be available, and the possibility deserves consideration.

Nickel and Sulphur are both important minerals for the Iron & Steel industry and both are available as waste products in the treatment of the Copper Ores of Mosaboni at the plant of the Indian Copper Corporation.

Whether the small quantities of Beryl available in the Mica field of Kodarma would justify the treatment of the waste dumps of that area is a point on which we have no information, but the matter merits investigation.

Summary

We may sum up this section on the beneficiation of ores as follows:—

(a) No beneficiation of iron ore is required in India to raise the iron content, but sintering of soft and powdery ores is desirable and may prove economically sound. Laboratory experiments on this are of no value. A large scale installation will be somewhat speculative but might justify itself.

(b) Indian Coking Coals are not of good quality so far as ash is concerned. Unfortunately they are difficult to clean, but the attempt is well worth while and various Companies have been, and are still making experiments to this end. Further work is desirable.

(c) The separation of the Orissan Iron-Manganese ores into high Manganese and high Iron components is well-worth investigation, and research work is needed here.
(d) The deposits of Limestone and Dolomite within reasonable distance of the Iron & Steel Plants are of good quality and do not need beneficiation.
(e) India's Magnesite is also of pure grade.
(f) Much of the Chromite of Singhbhum can be concentrated with satisfactory results.
(g) Further investigation on Vanadium, Nickel, Sulphur and Beryl is desirable.

APPENDIX "A"

Raw Materials Despatch and Consumption.

Material	1933-34		1934-35		1935-36		1936-37		1937-38	
	Despatches from Company's Mines	Consumption	Despatches from Company's Mines	Consumption	Despatches from Company's Mines	Consumption	Despatches from Company's Mines	Consumption	Despatches from Company's Mines	Consumption
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Coal	3,15,000	14,22,000	3,22,000	14,03,000	2,92,000	15,13,000	3,47,000	15,45,000	5,79,000	17,05,000
Iron Ore	13,54,000	13,41,000	14,29,000	14,33,000	14,48,000	14,44,000	13,36,000	13,38,000	14,24,000	14,00,000
Limestone	38,000	3,98,000	30,000	4,33,000	40,000	4,47,000	18,000	4,50,000	31,000	4,61,000
Magnesite	2,000	5,000	4,000	6,000	3,000	5,000	2,000	8,000	3,000	8,000
Dolomite	13,000	25,000	19,000	35,000	63,000	37,000	39,000	36,000	31,000	34,000
Manganese Ore ..	24,000	32,000	4,000	28,000	15,000	25,000	15,000	24,000	26,000	22,000
Fluorspar	....	600	....	700	....	800	....	1,000	....	700
Sulphur	....	2,000	....	3,000	....	3,000	....	3,000	....	3,000
Chrome Ore ..	....	1,000	....	2,000	....	2,000	....	2,000	....	2,000
Fireclay	8,000	9,000	7,000	13,000	7,000	13,000	9,000	16,000	10,000	16,000

V

TRANSPORT IN CONNECTION WITH THE DEVELOPMENT OF MINERAL INDUSTRIES.

1. The development of industries is largely dependent on the existence of adequate facilities for the carriage of raw materials from the sources of supply to the manufacturing factories and of the finished out-turn of the factories to the destinations where the sales are effected.

2. Transport arrangements affecting industries, cannot be satisfactory unless they provide for the following:—

(i) The prompt and regular supply of wagons for the carriage of raw materials and finished products.

(ii) The supply of wagons of suitable types for loading and unloading and the conveyance of particular classes of materials, especially mineral materials of heavy density.

(iii) The quick movement of loaded wagons from points of origin to destinations.

3. We can only draw on our own experience, which is limited to the Bengal Nagpur Railway, to express any opinion on questions of fact relating to matters referred to in the preceding paragraph; and it is unnecessary perhaps to do more than to state the position with reference to present conditions. In this regard we consider that the facilities provided at present by the Bengal Nagur Railway for the carriage of raw materials to Tatanagar and of the finished products from Tatanagar of the Tata Iron & Steel Company, Ltd., are generally adequate and suitable. This is all the more creditable to the Railway having regard to the very large density of the traffic hauled as will be evident from the figures in the table below:

Statement showing the amount paid by the Tata Iron & Steel Co., in freight charges on Raw Materials despatched to Tatanagar during the year 1938-39.

Name of Raw materials.	Density in Ton-miles of traffic in 1938-39.	Amount paid by the Tata Iron & Steel Co. in freight charges.
		Rs.
Coal and Coke	21,97,01,167	51,97,120
Iron Ore	10,03,84,313	20,57,418
Manganese Ore	2,16,39,478	2,56,039
Dolomite	22,78,915	33,152
Lime Stone	6,58,08,137	8,99,050

Chrome Ore	1,21,095	1,651
Fluorspar	1,39,680	2,083
Sulphur	3,37,876	24,016
Raw Magnesite	5,64,138	12,159
Fire Clay	19,29,342	57,360
Total ..	41,29,04,141	85,40,048

4. That there is room for improvement in the existing transport facilities is not denied, and in order that the most effective arrangements both for the industry and the Railway should exist, the Railway have posted a Traffic Officer of experience temporarily at Jamshedpur to examine, in collaboration with the executives of the Steel Company, the possibilities of effecting further improvements.

We are unable to say whether the transport arrangements which exist at present for the handling and carriage of the commodities of other industrial concerns by the Bengal Nagpur Railway and other railways are adequate or otherwise, as we are not in possession of any reliable information on the subject.

5. Economy in the operating cost of Railway acts as an incentive to the provision of better transport facilities for industries and to the trade interests in general. Industrial concerns, especially those offering large density of traffic to the railways, can do much to assist the railways in keeping down their operating costs. This can be accomplished chiefly by indenting timely for empties, by providing proper facilities for the quick loading and unloading of wagons, and by returning empties to the Railway without any delay and with no desire to retain them up to the free time allowance under the Demurrage Penalty Rules.

6. The interests of railways can also be served by industrial concerns providing return loads wherever possible in order that the empty haulage of wagons by the railways might be reduced to a minimum. Further, concerns which offer a very large density of traffic to the railways will assist the railways to reduce their operating costs if train loads are regularly made up for despatch.

7. The best arrangement for the transport of materials of the Mineral Industries by the railways can only be secured by co-ordinated action on the part of the industrial concerns and the railways. The difficulties peculiar to each should be understood and appreciated by the other. With a real desire on the part of each to promote the interest of the other, and to recognise that there must be a measure of give and take in order that the greatest possible benefit may be secured to

both, there should be no bar to the introduction of transport arrangements which would adequately meet the needs of the industries. One practicable way, in our opinion, of obtaining the best result would be the establishment of a standing committee of officials from the industries and the railways, charged with the duty of constantly examining the transport arrangements with a view to suggesting changes involving improvements in them as occasions demand.

8. Adequate transport arrangements by railways presuppose that the rates charged by the railways for the carriage of the commodities of the industries are reasonable. All too often Railway administrations in fixing freight rates proceed on the assumption that the theory expressed in the words "what the traffic can bear" means the maximum rates that can be imposed on particular commodities without lowering the gross earnings of the Railways therefrom. This assumption is entirely erroneous, and the proper application of the principle or theory referred to, as explained by many authorities, is the fixation of rates at a level which pays regard on the one hand to the actual cost of the services rendered by the Railway, and on the other hand to the maximum limit which the traffic can bear without contraction.

9. Nor can the necessity be overlooked for the fixation of low rates, in order that new industries may be fostered and developed. Special low rates both for raw materials and for finished products were quoted by the Bengal Nagpur Railway for the Tata Iron & Steel Company, the Bengal Iron & Steel Company, and the Indian Iron & Steel Company during the earlier years of their existence. And the present comparatively prosperous position of the Bengal Nagpur Railways is due in no small measure to the adoption of this wise policy.

10. We have made an exhaustive examination of the freight rates at present in force on the Bengal Nagpur Railway, the East Indian Railway, and the Bengal and North Western Railway for the following commodities namely—Iron Ore, Limestone, Dolomite, Manganese Ore, Magnesite, Fireclay, Coal and Coke. These rates consist of basic rates, and special lower station to station rates. That a very large number of station to station rates are in existence is evidence that the Railway Administrations have given particular consideration to the rightful claims to special low rates of particular industrial and trade interests.

11. In our opinion, rates quoted for raw materials of other concerns by three railways referred to appear to be not unreasonable except in regard to coal and coke. We must qualify this observation, however, by saying that too much

reliance should not be placed upon it as we are not in full possession of the stage of development or of the financial prosperity of many of the undertakings affected.

12. Our examination of the rates of the Bengal Nagpur Railway in so far as they affect the Tata Iron & Steel Company leads us to the conclusion that they are not unreasonable, except in some degree in the matter of the rates quoted for the conveyance of finished products, and in a very marked degree unreasonably high for the conveyance of coal and coke traffic.

13. Coal is a key industry, and the freight charges on coal form an appreciable part of the cost to the consumer. The availability or otherwise of cheap coal to the industries make or mar their existence and development.

14. It is no less in the interests of the industries than of the Railways who benefit by the expansion of the industries that the coal rates should be fixed at a low level. Railways, in our view, should not expect to earn from the carriage of coal more than what is sufficient to cover their operating costs and to meet interest and depreciation charges on the capital cost of the facilities for the handling and transport of coal. The time has come, in our opinion, when an exhaustive examination should be made by an independent Committee with a view to ascertaining what the all-in-costs of handling and transportation of coal are, in order that a reasonable scale of freight rates might be determined upon.

VI

LABOUR IN CONNECTION WITH THE DEVELOPMENT OF MINERAL INDUSTRY.

1. The establishment and labour required for the Mineral Industry fall broadly under the following main divisions:

(1) The Superior Supervisory Establishment.
(2) The Subordinate Supervisory Establishment.
(3) The Subordinate Technical Establishment.
(4) The Skilled, Semi-Skilled and Unskilled labour.

2. The best way of indicating what categories are generally grouped under each of the divisions referred to in the preceding paragraph is by way of illustration. Taking one of the largest Mineral Industries, namely the Coal Industry, the grouping is somewhat as follows:

(1) Superior Supervisory Establishment:
The Chief Mining Engineer
The Agent of the Mines
The Managers and Assistant
The Managers of the Mines
The Electrical Engineer and the Asst. Electrical Engineers
The Mechanical Engineer and the Asst. Mechanical Engineers
The Head Store-keeper
The Chief Officer in the Power House
The Labour Officer.

(2) Subordinate Supervisory Establishment:
All those engaged in work wholly or almost entirely of a supervisory character but who do not fall under the group of the Superior Supervisory Establishments fall under this division; and it includes all Foremen, Supervisors, Overmen, Medical Personnel, the Depot Store-Keepers and the Chief Clerks in the various offices, including the offices of the Managers of the mines.

(3) Subordinate Technical and Clerical Establishment:
This division is comprised of all technical employees such as Fitters, Machine Men, Checkers, Tindals, Drivers, Firemen, Drillers, Carpenters, Clerks of all grades other than Chief Clerks, and Time-keepers.

(4) Skilled, Semi-skilled and Unskilled labour:
The rest of the labour force falls under this last

division. It includes the Mining Sirdars, the Underground Supervisors, the Car Checkers, the Jamadars, Masons, the Line Mistries, Mates, the Miners and Loaders, the Khalasis and the Coolies.

3. One of the primary essentials for the efficient and economical working of any industry is that the establishment and labour force should be adequate and efficient from top to bottom. Adequacy does not imply anything more than a force of sufficient strength to ensure the successful operation of the industry from every point of view. Top heaviness must always be guarded against. Efficient and sympathetic supervision, modern equipment, rapidity of operations, a high level of production at low production costs, and the best possible arrangements for protecting the workers against over work or unsuitable conditions of working, and against risk of injury or death are amongst the chief factors which make for the success of an industry.

4. The most efficient force of establishment and labour can only be secured if proper attention is paid to the recruitment of suitable candidates to fill vacancies in the force whether the appointment is to vacancies in the Superior Establishment or in the lowest rungs of the ladder. A necessary supplement to proper recruitment is the existence of suitable arrangements for the training of members of the establishment and labour force, firstly to perform to the higher degree of efficiency the duties of posts which they fill, and secondly to qualify for promotions to higher appointments. The arrangements for filling posts should provide more and more for posts in the higher categories being filled by the promotions of suitably qualified persons already in service than by direct recruitment. Such an arrangement brings about a greater contentment and efficiency among the employees with consequential advantage to the employer.

5. It has been found up to now that the best method for filling posts in the Superior Supervisory Establishment is by direct recruitment to the lowest grades of categories in this division of qualified candidates, usually technical graduates. For a small part vacancies in the higher grades have been filled by direct recruitment of specially qualified persons; and also for a small part vacancies have been filled by promotions of qualified employees in the Subordinate Supervisory categories.

6. There is no dearth at present of fully qualified candidates for direct recruitment to the lower grades of categories in the Superior Supervisory Establishment, but to meet the increased demands for suitable candidates for the Supe-

rior Supervisory Establishments which will arise with the development of the industries, arrangements should be introduced without delay whereby employees in the Subordinate Supervisory division should have the opportunity to qualify by experience and by obtaining the necessary academic qualifications (where this is absolutely necessary) to fill in larger numbers than at present posts in the Superior Supervisory Establishment. It might also be necessary, later on, to encourage a larger number of students to obtain the prescribed minimum academical qualifications.

7. No difficulty is also experienced at the present moment in obtaining qualified candidates to fill posts in the Superior Supervisory Establishment either by direct recruitment or by promotions of suitably qualified employees. Here too arrangements should exist for training selected employees in the lower grades in larger numbers than at present, to fit themselves to fill posts in the Subordinate Supervisory Establishment.

8. The supply of qualified technical men and of clerks for the third division of the establishment force is at the present moment in excess of demand. If, however, any large development of the Mineral Industry is to take place in the near future, it is quite likely, unless something special is done timely to arrange that candidates with technical skill would be forthcoming in larger numbers than at present from the lower grades, difficulty will be experienced in obtaining recruits with the necessary technical skill to fill posts in this division other than the posts in the clerical establishment. One method of securing the necessary supply of suitably qualified technical men for this division of the force is to induce the Railways and other large industrial concerns, like the iron and steel manufacturing undertakings, to train technical apprentices in numbers somewhat in excess of their own actual needs. The surplus so trained will be available for employment in the Mineral Industry.

9. The labourers required for the last division should as a general rule be recruited as unskilled workers from young men of robust health. The medical fitness of each person should be tested before engagement. Wherever possible men who live in the vicinity of the particular industry and who are not likely to leave their employment in large numbers during the sowing and harvesting seasons should be given preference over others.

10. Vacancies in the categories of semi-skilled and skilled labourers should as a rule be filled by promotions from the ranks of unskilled labourers. Such an arrangement

will act as an inducement to many of the unskilled labourers to take a keen interest in their work, and to acquire some knowledge of the methods of working which are directed towards increasing the out-turn of the workers and reducing production costs.

11. All categories of workers in the fourth division, and especially the unskilled labourers, should, in their own interests as well as of the industry, be educated to perform their own duties efficiently, and selected members of the force should be educated and trained to perform duties of a more responsible nature than those on which they are engaged.

12. The arrangements for affording the necessary education and training should be of a simple character which takes into account the fact that a large proportion of the labourers are illiterate or have attained only a low grade literacy.

13. The best can only be expected from any body of workmen if the employer does all that is reasonable, within the limits of economical working of the particular industry, to convince the workmen that they receive considerate and fair treatment. This presupposes the existence of a suitable scale of wages, and an organisation which affords reasonable prospects of advancement carrying with the advancement increased wages; which ensures reasonable hours of work, provides for holidays on a suitable scale and for opportunities for recreation; which provides for the education of the children of the employees; which ensures that proper arrangements exist for the medical care and attention of the workmen; which recognises the necessity of providing adequate and suitable housing accommodation where such is not available or available only to a limited extent; which provides for the security of tenure of employment and for a provision for the workmen themselves and their families on superannuation and for their families in the event of premature death.

14. All these and other matters of a like nature have been placed in the forefront of the policy of the Tata Iron & Steel Company and of all other good employers. What the Tata Iron & Steel Company has done in regard to these matters is exhaustively described in a book entitled the "Report on the Conditions Affecting the Labourers of the Jamshedpur Works of the Tata Iron & Steel Company Limited", and in the Answers by the Company to the Questionnaire of the Bihar Labour Enquiry Committee. These Answers give information not only in regard to the Steel Works proper but to the Collieries and Ore Mines in the Bihar Province worked by the Tata Iron & Steel Company Limited.

15. The Answers to the Questionnaire of the Labour Enquiry Committee can, it is understood, be obtained from the Secretary of the Labour Enquiry Committee, Bihar. A copy of the book entitled "The Report on the Conditions Affecting the Labourers of the Jamshedpur Works of the Tata Iron & Steel Company, Limited" is sent with this Memorandum.

16. It is recognised that in some directions at least further legislation is urgently needed, on the one hand for securing the workmen their legitimate claims, and on the other hand for protecting the industry and the employers against unreasonable demands and unsatisfactory behaviour of the workmen which at times arise by their being misled by unsuitable labour leaders or unions or by disorderly and unruly elements who act more for embarrassing the employers than for protecting or advancing the interests of the workmen.

17. Without industrial peace, industrial development cannot be achieved. Industrial development depends on the availability of new capital and new capital will not be forthcoming unless arrangements exist for the speedy and satisfactory settlement of differences and disputes that occur between the employees and employers. Nothing is further from the minds of those who have drafted this Memorandum than that legitimate aspirations and claims of the labourers should be denied or suppressed. What is required, in their view, is that there should be a proper balancing of the claims of labourers with the interests of the industry and the employers. The existence of proper machinery to act for conciliation or arbitration promptly, fairly and effectively whenever disputes arise is a much felt want. Here is one direction in which new legislation seems to be urgently called for.

18. Another direction in which legislation appears to be overdue is the extension to the Province of Bihar of a law similar to the Bengal Goonda Act. The desirability of removing goondas and hooligans from the Jamshedpur Industrial area is a matter in regard to which the employers, representatives of labour and impartial authorities are in complete agreement.

19. The Bihar Labour Enquiry Committee, it is understood, is making an exhaustive examination of all questions affecting the legitimate claims of labourers; and we believe that the Committee will make definite recommendations as to what additional legislation should be introduced in order to secure to the labourers their legitimate rights and to afford means whereby the industries and the employers will be protected against unreasonable action on the part of the workmen, labour organisations or unruly characters.

20. This being the position we are reluctant at present to say more than we have on the subject of labour legislation. We shall, if necessary, revert to the subject after the Labour Enquiry Committee's Report is published.

Appendix II

MEMORANDUM ON THE PRESENT MINERAL PRODUCTION OF INDIA AND ITS FUTURE POSSIBILITIES ESPECIALLY AS REGARDS THE NON-METALLIC MINERALS BY D. N. WADIA.

A review of the list of the mineral products won in India today and the appraisal of the total mineral resources of the country so far known to geologists brings home the fact that the mineral wealth of India is not of "enormous" proportion, as is at times declared by some publicists and economists, but except in minerals such as iron-ore, aluminium-ore and possibly mica and titanium, the deposits are of a decidedly limited extent and need a policy of strict conservation and planning in the interest of future national needs. This opinion receives confirmation from the experience derived from the last half-century's systematic mining work carried out in the country. Chances of discovery of new mineral deposits of any extent and richness by the old-time methods of surface prospecting are now not many, though the new geophysical methods of locating underground mineral occurrences—methods which have hardly received any systematic trial in this country—seem to offer some possibilities of bringing to light hitherto undiscovered, but in some cases suspected, deposits such as petroleum, coal-measures, natural gas, metallic lodes, etc.

On the other hand the known mineral resources of India, though limited, are by no means inconsiderable or poor; and encompass a sufficient range of useful products that are required to make a modern civilized country more or less industrially self-contained. In the case especially of some non-metallic minerals, the available resources may be considered ample, capable of considerable economic expansion, several times their present insignificant production. The freest scope for expansion of India's mineral industry exists for the latter class of minerals which, needing comparatively small capital outlay (as compared with the huge metal-production plants) are capable of giving remunerative employment to the educated middle class, and at the same time reacting favourably on the general industrial outlook of the country.

India's resources in minerals of strategic importance—minerals for munition and defence armaments are rather deficient especially in tin, tungsten, lead, zinc, graphite and liquid fuels, though in the basic metals, iron, manganese and

chromium it is well supplied, in the case of the former two in large excess. Our neighbour Burma has abundant stocks of the munitions metals of which India is in defect, while her oil resources must yet be regarded as considerable. Ceylon has reserves of the world's finest graphite and of a magnitude sufficient to last a long period.

The gravest defect of the present-day mineral industry of India is that by far the largest quantity of the produce of our manganese, mica, chromite, ilmenite, refractory and some other mines are extracted mainly for the purpose of the export trade and at a rate which will in course of but few years deplete the reserves of valuable key-metals and accessory minerals.

More than 20,000,000 tons of manganese ores have left the country during the last 18 years, the price obtained for it being ridiculously low, the exporters having to pay the heavy cost of transport to the consuming countries. This export of manganese has been carried out not by genuine miners, but largely by traders, on much the same principles as trade in cotton, jute and wheat, regardless of the fact that the metals are a rapidly wasting asset of a nation, and that no geological processes or fertilisers will replenish the exhausted mines, as in the case of the field produce. India is thus not only so much the poorer by the loss of a metal of industrial value, but has to pay a penalty in the shape of cost of export, leaving but little for the bare value of the ore. At the rate of export that has gone on in the past years, it is possible that at some future date, when India has begun to utilise to the full her metallurgical resources in iron, she may have to import manganese from overseas at several hundred per cent premium over the price she is receiving today for her outward shipments.

In any scheme of planning for future the enforcement of two measures is called for; (1) some check on the unrestricted export in the raw state of manganese-ores, chrome-ores, mica, ilmenite, phosphates and sillimenite; and parallelly with that, (2) provision of every facility for free technical advice, information on mining methods and practice, etc., for minerals which are mined for home manufactures. Minerals which come under this category, and which are available in fairly large quantities in India, but which are scarcely put to one tenth of their potential use, are various clays and earths, asbestos, barytes, mineral pigments, marble, granite and other ornamental stones, refractory minerals, *reh* and *usar* salts for sodium and alkaline compounds, sulphur contained in the sulphide ores, phosphates, industrial utiliza-

tion of bauxite, (besides smelting for aluminium, gypsum. mica, ilmenite, magnesite and zircon).

It is apparent that steps for the achievement of the second of the above aims can be taken more easily and earlier than for the first. With this end in view, I suggest that the Mining and Metallurgical Sub-Committee should form itself into an Advisory Council for providing free and effective guidance, information and technical advice to intending miners and manufacturers of mineral products. The capital and initial outlay required for many of the above enumerated mining projects is not likely to be beyond the resources of the Indian mercantile community. The chief impediment hitherto has not been capital but lack of knowledge of the uses of minerals in industry and of manufacturing technology. With the increase in the number of industrial chemists and geologists in India these mineral industries acquire a better outlook.

Legislative action being required for the first of the above objects (which is intrinsically no less important than the second), the subject is outside the scope of the present Memorandum.

The main object of this Memorandum is to draw attention to industrial capabilities of those minerals with which the country is supplied, but which are either partially or entirely neglected, or but inadequately employed, in the manufacture of products which the country has begun to use in increasing quantities, acquiring its supplies from overseas sources.

In the list given below, all the items, except asbestos and barytes, occur in quantities sufficient to meet any demand that is likely to be made by indigenous industries for many years.

The sub-joined notes on these minerals contain only a few broad facts and suggestions regarding their economic appliances and the scope that exists in India for these raw mine produce. I shall be glad to give fuller details, statistics, information as to the occurrence, distribution in the Provinces, and the conditions of mining of these minerals, on specific inquiries being made:—

Asbestos	Magnesite
Barytes	Marble & ornamental stones
Bauxite	Mica
Beryl	Mineral paints
Clays	Monazite
Glass-making materials	Phosphates
Gypsum	Sodium & alkaline compounds

Ilmenite	Sulphur
Kyanite and sillimanite	Zircon.

ASBESTOS—There are good prospects for an asbestos industry in India. The mineral is finding ever widening uses in the manufacture of a variety of products for which the short-stapled, brittle-fibred Indian asbestos is quite suitable. The high-grade spinning quality asbestos is rare in India, and this fact has so long condemned Indian asbestos for certain manufactures, but the domestic grades available from deposits in Seraikela, Cuddapah and Mysore State can be employed for the manufacture of insulating materials, mill-boards, wall-boards, sheets, asbestos cement, roofing boards and titles, fire-proof appliances etc., the Indian consumption of which is to the order of 32 lacs of rupees per annum. This is all supplied by imports.

BARYTES—The chief barytes consuming industry is paints and colours manufacture, the imports of which aggregate one and a quarter crores. Barytes has lately entered the list of Indian mines products which are being put to use in internal industries, the Kurnool mines being the chief source so far exploited, though other promising areas have been prospected. The barytes won in India is further supplemented by imports up to 2½ lacs of rupees per annum. (See notes on Mineral Paints).

BAUXITE—Nowhere is India's backwardness in utilising its mineral wealth more patently seen than in its failure to work the rich deposits of bauxite, (aluminium-ore). Hundreds of millions of tons of this ore occurs in Bihar, Central Provinces, Bombay and Kashmir, in situations requiring the simplest of mining operations for its extraction. Of the two serious obstacles which have so far hindered any development project, one has disappeared, viz. non-availability of cryolite, an essential accessory used as a solvent for alumina in the electrolytic production of aluminium, and the other (the easy access to high potential electric current) required in the smelting of the ore is likely to be in a short time removed with the maturation of the projected schemes of hydro-electric power plants. The further outlook of aluminium production in India, therefore, will no longer be governed by these insuperable difficulites, but by factors of internal trade economics, competition with foreign manufacturers, favourable location with respect to power supply, etc.

Bauxite however, has a number of other economic uses and applications, besides being a source of aluminium metal; viz. manufacture of cements, abrasives, refractories, various

chemicals, refining of petroleum. In these the small scale manufacturer has a good field in India, for increasing uses are found for these minor products, viz. bauxite cement, artificial abrasives, bauxite bricks and furnace linings, preparation of various aluminium salts (alum, aluminium sulphate. chloride and hydrate) and bauxite filters for decolourising mineral oils.

BERYL—The commercial source of the rare metal beryllium occurs in Ajmer-Merwara, Nellore and at Kodarma in pegmatite-veins of considerable size. The U.S.A. users have found Indian beryl to be the best ore offered from any part of the world, yielding as much as 13 per cent of beryllium oxide. This metal is used for beryllium-copper and other alloys, and for some patent technological appliances in a few specialised industries, for which there is no field in India today. In the absence of any domestic need, this mineral could be profitably exported.

CLAYS—The mineral statistics of industrially advanced countries reveal the important part played by clays in the country's industries; its magnitude can be judged by the fact that the U.S.A. manufactured clay-products total $672,000,000 in value in one year. There is an abundant supply of suitable grades of clay in India, including those in demand for various industries. The principal workable Indian deposits consist of: (1) China clay, or Kaolin, fit for procelain and better-grade pottery, earthenware, art-paper, etc. These deposits are widely scattered especially in the granite areas and in the Gondwana countries. (2) Fire-clay for refractory bricks, furnace-linings, foundries, etc., for which purpose the Raniganj and Jubbulpore clays have proved equal to the best imported material. (3) Stone-ware clays for various kinds of earthenware, terracotta, Art-ware, are clays possessing a long vitrification range and vitrifying at lower temperature; their occurrences are similar to those of the above clays. (4) Fullers earth, non-plastic earth, with detergent and colour-absorbing properties, and bentonitic clays ("soapy" clays of high absorbent powers for water) are available for various technical uses which will increase in number and importance, with the general industrial development of the country. The former variety is more wide-spread in its occurrence than the latter group of clays which is restricted to Jammu and Jodhpur.

In so far as easily accessible raw materials and the accessory ingredients required for the sustenance of this industry are concerned, there is no reason why a more vigorous clay manufacturing industry should not develop in India to meet the heavy indigenous demand which, even in respect

of the less widely used articles, goes up to over a crore of rupees in one year.

GLASS-MAKING MATERIALS—Among the major imports of India, which have mineral bases, glass occupies a prominent place. The discovery during recent years of more workable deposits of quartz sand of the required grade and purity, of nepheline-syenite rock as a suitable base for medium quality glass, and the prospect of locally made cheaper sodium carbonate (a large item in the bill of costs) being available, will, it is hoped, place the glass industry of the country, which has survived a long period of difficulty, on a promising footing. Fuel, refractories, accessory and control chemicals needed by the industry raise no particular problems.

The difficulty of obtaining supplies of pure quartz sand can be overcome, where other factors are more favourable, by the use of crushed, milled and graded quartzites and sandstones, containing 98 per cent iron-free silica; these occur in the geological formations of many parts of India. The nepheline-syenite rock which, as has been lately demonstrated by Dr. Dubey's experiments, is suitable as a base material, is available in large quantities, though it is of more restricted distribution in India.

GYPSUM—This is the raw mineral for the making of plaster of Paris, a substance that is finding ever-increasing employment in the building works, mouldings, fire-appliances and in the manufacture of plate-glass, terra-cotta and pottery. Crude gypsum is used as a subordinate ingredient in cement manufacture and as a dressing for agricultural lands, where in small quantities its beneficial effects on some monsoon crops, and on winter crops like wheat, has been experimentally demonstrated. Readily available supplies of thousands of millions of tons of gypsum are not utilized in any adequate degree in the North-West Punjab, Himalayas, Cutch and Rajputana, as is evident from the price the mineral fetches, from Re. 1 to Rs. 2 per ton. In spite, however, of this low cost the production of gypsum so far recorded is insignificant. The total tonnage absorbed in agriculture and industry barely totals 50,000 per year. The mining of gypsum is simple open-cut quarrying, and rail transport facilities exist for the vast Salt Range deposits in North-West India.

ILMENITE—This is an ore of titanium metal, of which India holds large reserves, measured by hundred million tons. The ore occurs in the form of loose sand covering a strip of the Travancore beach for over a hundred miles, the heavy sand being concentrated in this situation by the action of the

sea-waves to a wonderful degree of purity. Its only associate grains are monazite, rutile and zircon.

Almost the sole use of this magnificient asset up to now has been the export of raw ilmenite sand, after further concentration and separation from monazite, rutile and zircon, to the U.S.A. and Germany in bulk which has now reached the yearly total of 120,000 tons. India has become during the last few years the largest producer of ilmenite in the world. The price realized is barely Rs. 15 per ton f.o.b. Travancore, which is a small fraction of the price of titanium dioxide, the compound into which the largest amount of the ore is converted by the manufacturers.

The industrial uses of the mineral are in the making of ferro-titanium alloys, but much the largest quantity is absorbed in making of high-grade paints and pigments, for which titanium dioxide possesses certain remarkable properties. The industry has within recent years reached phenomenal proportions with steadily expanding market. The manufacture, however, is covered by a large number of patents, mostly owned by the big producing firms; the various chemical processes involved being jealously guarded trade secrets.

While there is justification for the export of certain proportion of the large reserves of this mineral in the absence of domestic consumption, its continued indiscriminate export on the scale that is going on today is nothing short of waste of an important natural asset, for which there is a very poor return. There should be no insuperable difficulties in the acquiring of patent rights or perhaps in devising new workable methods of preparing titanium dioxide from the ore by our chemists. If the finished product of commerce cannot be made in India it may be found possible to carry out the initial processes in the manufacture of titanium pigments at competitive prices.

KYANITE, SILLIMANITE AND ALUMINOUS REFRACTORY MINERALS—India possesses considerable deposits of these refractories. The large supplies available at Rewa and the Khasi Hills are of good quality and in active demand for metallurgy. Of recent years these deposits have been drawn upon by the Indian metallurgical and other works, while there is a steady demand for sillimanite and Kyanite from abroad, especially the U.S.A. The home demand needs to be encouraged to supply more and more local requirements, while it is desirable the output of this valuable raw material for export purposes in the crude state may be restricted by quota or some other restrictions.

Other refractories available in India for metallurgical as well as ceramic and glass furnaces, kilns, melting pots, etc.

are magnesite, graphite, fire-clay, chromite, quartz, bauxite and zirconia, all of which occur in deposits of considerable size and in quality ranging from average to good.

Inexhaustible quantities of pure, white quartzite, sandstone and reef-quartz, containing over 98 per cent of silica are found in almost all provinces of India, and are suitable for manufacture of silica-bricks. The Kumardhubi silica bricks have established a reputation, and are well capable of withstanding temperature up to 1,700°C.

While considering refractory substances, the question of fluxing materials used in the metallurgy of iron may be dealt with here. Existence of suitable supplies of these materials needed in the blast-furnace reduction of iron-ores in quantities up to 30 per cent of the ore charge, is of economic importance. The most usual fluxes employed in India are limestone, dolomite, and apatite, and although supplies of the first two may be considered practically unlimited for all purposes in India, their distance from the chief metallurgical centres often is a matter of expensive transport.

MAGNESITE—The source of magnesia and, as recent research has made practicable, of metallic magnesium occurs in Madras in large deposits which may be considered for all practical purposes almost limitless. The Madras magnesite likewise is of a high grade of purity. Caustic and dead-burnt magnesia produced on the spot find a limited employment in India, the former as a cement, the latter as a refractory; the larger proportion however is shipped to Europe and the U.S.A.

In view of the world's ample supplies of magnesite, the surplus Indian magnesite has not a promising prospect for export trade, but as a source of good grade refractory for our developing iron and steel, and possibly other metal, industries it is of high future value. Magnesia cement also should find increasing application in the making of artificial stone, fire-proof partitions, tiles, etc. for the vast plain tracts of India where stone of any description is rare.

Of recent years Europe has perfected the process of manufacture of magnesium metal out of various magnesium minerals on a commercial scale; and metallic magnesium is made and used in considerable amounts in the "light alloy" industry. Technical difficulties besetting the old process of reduction of this metal have been overcome to such an extent that last year the production reached 25,000 tons. A new avenue for utilization of the large superfluous reserves of our magnesite is thus opened and it is possible that the less pure (more dolomitic) crude magnesite may be found suitable for this purpose.

MARBLE AND ORNAMENTAL STONE—With abundant supplies of marble and ornamental stones of great beauty available in various provinces in India, the country has depended almost entirely upon Italian and other imported marble to satisfy what demand there is. This is due to the ready availability of dressed and polished material suitable to various requirements from the foreign markets and the absence of any ornamental-stone dressing quarries or works in India turning out products of equal range and utility. A remunerative trade in this direction can be established in association with the Rajputana, Jubbulpore and other marble quarries, the various South Indian granite quarries, and the numerous quarries of un-rivalled Vindhian sandstones scattered through the central parts of India, where beautiful material fit for architectural, statuary and monumental purposes is present in unlimited volume in blocks, slabs, pillars, and monoliths.

MICA—India heads the list of world supplies of this mineral, its large deposits of flawless, colourless and transparent sheet-mica of good size having given it a virtual monopoly and dominance over the world-markets for high-grade mica. During the last two decades or so India supplied nearly 76 per cent of the world's trade requirements in this essential accessory of the electrical industry.

Mica mining in India has during the past years won large profits, but very little development work has been done and today the industry cannot be said to be in a healthy condition, the unscrupulous trade-practices of some of the dealers being responsible for diminishing India's dominance in this field and for deflecting the demand to the smaller producing countries.

The chief use of mica is as an insulating medium in the electrical industry. Practically the whole output of the Bihar and Nellore mines is exported in the manufactured conditions, comparatively little indigenous use being made for the country's increasing requirements of electrical machinery or equipment.

A more serious drawback of the mica mining industry is the enormous waste involved in the trimming and dressing of the crude mica—between 70 and 80 per cent of the crude mica brought out from the mines being dumped as unmarketable refuse. Thus enormous heaps of trimmings and splittings have grown near the Hazaribagh and Nellore mines. This waste or scrap mica is ground to fine powder in the U.S.A. for various uses in electrical insulation, and the small splittings are bound flat and pressed with an insulating medium,

like shellac, into good-sized sheets, "micanite." Thousands of tons of this reconstructed mica can be made out of the scrap discarded at the Bihar mines, but so far attempts to make micanite in India have failed; the matter, however, needs more careful experimenting and serious organized efforts.

Future possibilities of development of mica industry lie in better scientific equipment and working of the mines, less wasteful methods and persistent experimenting to convert the vast accumulations of scrap mica into a marketable product. Unless this is done, India will steadily lose its premier position in the world mica markets and the high prices it is demanding for Kodarma and Nellore mica, and readily receiving, will be offset by diminished production from the mines, in a few years. Mere mechanisation of the mines, however, is not advocated so much as more systematic methods of stopping and following of the pegmatite veins underground.

Also it is essential that a beginning should be made for local manufacturing industry to use a part of the annual output of the mines for manufacturing parts of electrical machinery and appliances such as condensers and commutators for home consumption at least.

Unless such steps are taken to rejuvenate the industry, the present generation in India will lay itself open to the charge of wasting a national asset of high potential value for a small present gain. The case of ilmenite referred to above is another instance of an Indian mineral which occupies a ruling position in the titanium paints industry by sheer bulk of the exports of its crude mine produce. In this latter case there is not even the satisfaction of obtaining monopolistic prices.

MINERAL PAINTS—These include some metallic oxides, ochres, pulverised slate, or shale (carbonaceous, ferruginous, etc.) with such accessories as barytes, China clay, gypsum, graphite, asbestos, ground mica and steatite.

The domestic consumption of mineral pigments in recent years has grown to respectable proportions, amounting to nearly two crores of rupees. There is a wide range of ochres, generically called *geru*, of vivid yellow, red, orange, amber, sienne, met with in most parts of India. They yield, raw or burnt, pigments of fine texture and body on levigation. This is another case where small scale local industries can successfully replace imported compounds, for the indigenous raw materials, if carefully selected, are of better grade, while the majority of them are available at small nominal cost.

MONAZITE—This mineral is a source of the rare metal thorium and was in considerable demand up to 1922, India (Travancore) being the principal source of the world's supply. The monazite deposits of Travancore (existing in the form of beach sand in association with ilmenite) are the largest and richest in their thorium content in the world, the percentage of thoria being as much as 10, and though the need for thoria for use in the manufacture of incandescent gas mantles has now practically ceased for the present, any metallurgical or technical developments, or change of technology, may resuscitate the demand. Thorium (mesothorium) by atomic disintegration becomes a source of a series of radioactive elements which are finding therapeutic as well as economic appliances. Moreover, the bye-products of thorium salts and the two or three other rare elements associated with the natural mineral are likely to maintain a moderate demand for Indian monazite.*

PHOSPHATES AND NATURAL FERTILIZERS—All through the ages the Indian agriculturist has disdained the use of mineral fertilizers. This may be due to the comparative poverty of accessible phosphate deposits in the rock formations of the country. Geological surveys, however, have brought to light several moderately large deposits of phosphate-rich rocks and minerals in Bihar, Madras and Bombay, which after suitable treatment may be made fit for agricultural use. These mineral phosphates, supplemented by the phosphorus content in the yearly growing dumps of basic slag at the iron works (containing about 3 per cent of phosphoric acid) and sulphuric acid treatment of bone-meal, offer good possibilities for a super-phosphates manufacturing industry, the place for which in an agricultural country like India is sure to be recognised.

The scarcity of potassium minerals and salts (another ingredient of artificial manures) makes it imperative that all available phosphate materials should be conserved for agricultural needs.

Besides a few hundred tons of saltpetre—nitrate of potash—required for internal consumption as a fertilizer, most of the crude as well as the refined salt produced in India, about 8,000 to 10,000 tons per annum, is exported for munitions purposes to foreign countries. How far this drain upon this important source of potash and nitrogen represents a loss to Indian agriculture has to be investigated.

SODIUM AND ALKALINE COMPOUNDS—Millions of tons of sodium carbonate and sulphate are available from

* Since the above was written thorium has acquired a new importance in the world as being the source of atomic energy.—Editor

the surface soils of the United Provinces, Bihar, and some other dry alluvial tracts as alkaline efflorescences, known as *reh* and *usar*. E. R. Watson and K. C. Mukerjee, estimated in 1922 "that 7,321,000 tons of crude soda containing 4,888,000 tons of Na_2CO_3 could be obtained annually from the visibly efflorescent areas in the United Provinces." This may be too optimistic an estimate but it indicates the scale of magnitude on which these salts occur in some parts of India, and an organized attempt for economic working of these salts for various industrial purposes has yet to be made in India, though a few spasmodic efforts in this direction during the last 20 years have not achieved success. There are besides these soil efflorescences other notable reserves of soda salts in the Lonar lake and the alkaline tarns *(dhands)* of Sind. With annual requirements measuring 80,000 tons of alkalies (sodium carbonate and caustic soda) and nitrate of soda, valued at 1¼ crores of rupees, the prospects of the successful establishment of a soda-ash industry need to be further investigated in all its bearings.

SULPHUR—A cheap supply of sulphuric acid is a *sine qua non* of a flourishing mineral industry. India has no resources in crude or native sulphur but she has supplies of sulphidic ores of copper, iron, lead, and zinc which are at present all but neglected. Many of these ore-bodies are probably too lean to pay for the extraction of the metal alone but the demand for sulphuric acid in bulk should turn the attention of industrial chemists to this source of sulphur.

A practicable suggestion made by Dr. C. S. Fox in 1925 that the lead and zinc sulphide ores of the Bawdwin mines of Burma could be smelted in the vicinity of Calcutta or some point on the Orissa coast, is as fruitful today as when it was made and needs to be explored by interested parties. At present the sulphur of these ores as well as the Singhbhum copper-ores is being lost to the country whereas it can be recovered as sulphur dioxide in the roasting of the ores and converted into sulphuric acid with great commercial benefit to the nation.

ZIRCON—(Silicate of zirconia earth). A mineral of use as high-grade refractory in metallurgy, ceramics, etc. capable of withstanding extremely high temperature, as well as rapid variations of temperature, because of its low co-efficient of expansion, is a common associate of the ilmenite sand of the Travancore beach, of which it constitutes roughly 6 to 9 per cent. This is one of the mineral products the use of which is likely to expand and the large reserves of the mineral already proved in Travancore will be able to meet all likely demands.

Colombo, 6th October, 1939. D. N. WADIA

RESOLUTIONS OF THE NATIONAL PLANNING COMMITTEE ON THE REPORT OF THE SUB-COMMITTEE ON MINING AND METALLURGY

The Report of the Mining and Metallurgy Sub-Committee was presented by Dr. V. S. Dubey, Secretary of the Sub-Committee, on the 26th June in the unavoidable absence of its chairman, Prof. D. N. Wadia. Discussion continued on the 29th June.

The following resolutions were passed:

1. The mineral wealth of the country belongs to the community collectively. The exploitation of minerals and development of mining and mineral industries should be reserved exclusively to be carried on as public enterprise.

2. The mineral wealth is of vital importance to the nation. Most of the material imported at present, like metals, machinery, etc. is manufactured out of mineral raw materials. But sufficient attention has not been paid so far to the development of this mineral wealth.

Non-Metals:

3. (a) The country is well endowed in regard to the majority of non-metallic minerals, but most of the industries requiring these raw materials have not been developed. Most of the articles made from these minerals, and which are imported at present from abroad, can be manufactured in India.

   (b) The only important raw materials imported at present are salt and sulphur. Salt can be easily prepared in any amount in the country. Every effort should be made to find out if there are sulphur deposits in India. Attempts should also be made to manufacture sulphur or sulphuric acid directly out of gypsum, pyrites or other raw materials available in India.

   (c) Scrap mica, which is being wasted at present, can be utilised in various ways, and attempts should be made to do so.

4. Raw materials for nitrogen fertilisers, as well as to some extent for other types of fertilisers, are available in India. The synthetic fertiliser industry should therefore be started as recommended in resolution 3 (Red Book II, page 41) dealing with Chemical Industries.

Metals:

5. India has large deposits of iron ore, manganese, chrome bauxite and other metals. Except in the case of iron and steel, these resources have not been developed. These industries are essential for the general industrialisation of the country, as well as for defence.

6. Other metals, except copper and gold to some extent, are not being produced in India. Both copper and gold are being exploited by non-Indian concerns. An organised search for deposits of all such metals, which are so far lacking in India, should be made.

7. Restriction should be imposed on the export of ores of national importance, such as manganese, mica, ilmenite, etc. A definite policy should be laid down in respect of minerals of which India has a virtual monopoly, or of which she has a supply in excess of her requirements.

Fuels:

In regard to fuels the National Planning Committee has already passed resolutions when considering the report of the Power and Fuel Sub-Committee (Red Book II, pp. 65, 67 No. 2 (d) and 8).

Survey and Supervision:

8. The Central Geological Survey Department should carry out a thorough and complete survey of the mineral resources of India in all parts of the country, and should, for this purpose, be extended and adequately strengthened with expert staff.

9. The exploitation of minerals should be under the supervision of a Central Council for mining and mineral industry.

Waste:

10. The question of waste in the methods of mining and recovery of materials is very important in India. A detailed study of waste in various kinds of mining should be made by an expert committee and steps taken for its avoidance. Wherever possible this waste should be stopped immediately.

11. In view of the fundamental principle of the National Planning Committee's policy that all mineral wealth in this country belongs to the community collectively, and is to be exploited and developed as public enterprise, the problem of taxing, mining and metallurgical industries would not arise when the Plan we envisage comes into effect. Pending, however, the necessary readjustments as between that policy being given effect to and the present position of concession-

aires, taxation may have to be imposed on the concession, the production, the marketing and the profits of such industry.

Rules:

12. The existing rules and regulations regarding mining and prospecting are highly unsatisfactory, and should be revised, especially in regard to inspection of mining plant and working practices, so as to ensure the safety of workers, adequacy of plant, and efficiency of production. Indian nationals should be trained in sufficient numbers for all types of work, so as to be able to replace the foreign personnel now employed, within a short time.

Freight:

The National Planning Committee has already passed a resolution (vide Red Book II, p. 45, No. 21) regarding freight charges on railways, which would apply to freight on such heavy raw materials as minerals. In order, however, to give a comprehensive consideration to the question of transport charges in general, the entire problem be referred to the Transport Sub-Committee for closer examination and report on the principles which should govern it.

Tariff:

The suggestions that the Sub-Committee have made in regard to tariff on minerals should be considered when the general tariff policy is considered.

Minerals used for Defence:

Under clause (c) of this Sub-Committee's terms of reference, a classification was desired of mineral resources essential for national defence and those that were non-essential. The Sub-Committee is requested to deal with this reference in their final report.

QUESTIONNAIRE ISSUED BY THE N. P. C.

(1) (23) What are the chief mineral resources available in your Province? How far are these resources already being exploited, and developed, and by what agency?

(2) (24) What is the room for large-scale mineral, or metallurgical industries in your Province?

(3) (25) What is the policy of Government in your Province in regard to the grant of concession for the exploitation of mineral wealth in your Province?

(4) (26) Are there any Industries in your Province for the working up of the mineral raw material found in your Province in the shape of metal sheets and metalware of all kinds?

(5) (27) What agencies,—Local Indian, or Non-Indian —exploit the mineral resources of your Province, under what form of organisation and on what scale of production?

NOTE BY DR. V. S. DUBEY

Since the report was written, vast changes have taken place in India. The country has been divided into two parts, Hindustan and Pakistan. Thus a part of the mineral wealth of India has gone into Hindustan, and a part into Pakistan; and so it becomes essential to take note of this fact in framing our mineral policy. The other change has been that the importance of several minerals has greatly increased due to researches carried out in war period. The radio active minerals which were only of scientific importance some time before are now serving as the raw materials for the manufacture of atomic bomb and may serve in future as a source of energy in peace times. The light metals like aluminium, magnesium, beryllium have become of greater importance, as a large number of alloys have been developed from these metals which are of very great importance for the manufacture of aeroplanes which are going to play such an important part in future. With the advent of Swaraj the responsibility of defence has fallen upon Indian hands and the importance of key minerals needed for defence has increased. The problem of petrol which is a key material for peace and war has become more acute, as a part of its production which was already very short has gone to Pakistan; and whatever remains in India is in the eastern part of India in Assam with Eastern Pakistan intervening between that province and the rest of India. The result is that any war might find our supply of petrol completely cut off and hence the necessity of petrol for our armed forces has become very great, and it is necessary for self defence to make some suitable and sure arrangement for the supply of petrol in peace and war. As a result of intensive search for minerals during the war new deposits have been discovered and the already known deposits have been more intensively prospected while new industries have arisen requiring the use of minerals which were not used before, and the programme of development of means of communications will make many mineral areas accessible and thus open them out for development.

The new industries are being started such as the nitrogen fertilizer industry and the new plants for increasing the production of metals like iron, steel and aluminium and so it is necessary to take note of these in our mineral policy. The vast schemes of hydro-electric development which are being undertaken by the Centre and the Provincial Governments

have made it possible to develop several electrosmelting industries which are being worked with coal at present, especially the coking coal, the amount of which is limited.

A great change in the system of ownership of minerals is being affected by the abolition of zamindari in Bihar where the mineral rights belong to zamindars. Bihar accounts for about more than 70 per cent of the mineral wealth of India; and the abolition of zamindari will lead to the abolition of ownership of minerals by the zamindars and it will be possible for the Province to take up an intensive investigation of the mineral deposits and their development. The question of mineral taxation and the rules and regulations governing the exploitation of minerals also deserve a detailed study. The question of the right of the Centre as well as the Province as to the ownership and development of the important deposits is bound to be taken up in the new constitution and some detailed solution to this complex problem of the right of the Centre and the Province may be soon effected. The question of the nationalisation of the key industries such as coal industries and steel industries should also be considered as a long-range policy, though there may not be any immediate intention of nationalising these industries. The question of having bilateral treaties with our neighbouring countries for minerals of strategic importance required for defence which we do not possess in our country should engage the attention of the Government so that in future our defence position may not be impaired. All the problems enumerated above will be dealt with in a summarised form here.

The Division of Mineral Wealth in Hindustan & Pakistan

By the separation of a part of the country as Pakistan we have lost the most important salt deposit of India which is situated in Punjab near Khedwara. This deposit used to supply high quality salt to a good part of northern and western India. The deposits are very vast and their being cut off will affect the supply of salt to Northern India. There is no rock salt deposit at present in India being worked, but important deposits of salt occur in Mandi State near Jogendranagar in East Punjab. The deposits are quite large but the salt is mixed up with sand and is unfit for human consumption in raw condition. But by the system of mining the salt as brine it will be possible to manufacture common salt as well as the other compounds of sodium from that brine by evaporation and treatment. This deposit has got a great chance of development and if developed properly can replace the Khedwara salt now out of India. The other important deposits gone

out of India are the gypsum deposits. These vast deposits were associated with the salt and salt range in West Punjab. Gypsum had not much use except for cement. But the recent growth of ammonium sulphate has made gypsum a very important raw material. Gypsum cannot be replaced in the fertilizer industry unless we depend upon imported sulphur. We have got deposits of gypsum in Bikaner and Jodhpur, but in quantity the deposits are not quite satisfactory and so it will be difficult to replace gypsum from Indian sources.

Most of the petroleum deposits of Hindustan lie in the hills situated in the North West Frontier of India. We have got the refinery situated near Rawalpindi. All these deposits have gone outside Hindustan and the prospect of developing a petroleum industry on the western part of India is very small, while these petroleum deposits are likely to be of great use to Pakistan. Now the only deposits remaining in India are situated in Assam. In India we will have to transport petrol for a distance of more than a thousand miles if ever it is required on western Indian frontier operations.

As for coal, more than 98 per cent of deposits remain in India. The chief coal deposits which have gone to Pakistan are situated in West Punjab and are not of any importance. The coal reserves are very poor in quality and quantity. These deposits can supply only a very small fraction of the whole requirement of Pakistan and the country will have to depend either upon Indian coal or coal from South Africa. It is possible that the development of oil to some extent may replace coal but it is not possible that this may replace a large percentage of coal. As all the coal is of non-coking quality, the possibility of any iron and steel industry which require coal of coking quality is very small. All the bauxite deposits (ore of aluminium and manganese ore deposits) remain in India. An appreciable part of chromite deposits situated in Baluchistan have gone to Pakistan though sufficient chromite deposits are left in India for its own need. No precious mineral deposits have gone to Pakistan. On the whole it can be said that except for the salt, gypsum and a part of petroleum, India has not lost anything by the separation of Pakistan. On the other hand, Pakistan will have to depend upon India or any other country for the supply of a good deal of important metals and minerals including coal.

The Importance of New Metals and Alloys. During the war the use of aluminium has increased tremendously as it had been mostly used in manufacturing aeroplanes. In 1938 or 39 the consumption in U.S.A. was 257 million pounds, while in the post-war period it is expected to be 1500 million pounds, i.e. it has increased about six times. The manufacture of mag-

nesium which was very small (6 lacs) before the war has risen to 600 million pounds in 1943. This is due to the fact that new alloys have been manufactured which are essential for the aeroplane industry. Alloys of beryllium have also increased. Beryl and ore of beryllium which was produced as a by-product in the mica mining industry as a waste product are now being exported to U.S.A. for manufacturing light alloys. All these clearly show that the importance of aluminium has much increased during the last several years. In India it has become essential to develop this industry. During the war a Plant at Asansol began production. But the total capacity is not more than 3,000 tons a year. Recently another small plant is being installed in Travancore State. But the combined capacity of these two plants is very small compared to our total requirement. The lack of cheap power has stood in the way of development of these industries. Before the war coal was very cheap and so it was possible to produce cheap power in thermal stations. But with the rise of the price of coal to four times it is impossible to produce power cheap enough for the manufacture of aluminium. But at present there are several hydro-electric schemes being undertaken by the Provincial and Central Governments which will increase the power production to several million K.Ws. The power produced will be sufficiently cheap to allow the production of aluminium. The need of this country for aluminium is so great that all the hydro-electric centres of power production should plan the production of aluminium as in most of these centres bauxite can easily be made available. The Centre and the Provincial Governments should undertake to increase the production of aluminium and to start industries where aluminium can be utilised. The number of industries requiring aluminium is so large that it can easily be utilised for the manufacture of several things. The tremendous amount of power which is being developed will greatly help the production of magnesium as the raw material for this metal can be extracted from the sea. There is also the need of beryllium metal industry out of beryl produced in India. The need for the aluminium and its light alloy industry is so great that it is essential for the Government to have a detailed plan for manufacture of this metal in five or six centres of cheap power production, such as Madras, Bihar, C.P. and the eastern part of U.P. As far as the alumina plant is concerned, it will be economical to set up two or three alumina plants near the source of bauxite, and the alumina manufactured can be sent to the centres of cheap power for the production of aluminium. If we aim at producing 5,000 tons of aluminium per annum, the investment may be of the order of about Rs. 15 crores and the power required will be 1½

lac K.W. As regards the Government policy towards this industry, either this should be made a State owned industry or semi-State owned industry. Some of these aluminium manufacturing centres should also have magnesium industry and the manufacture of light alloys. Besides this we must have the engineering industries which may consume this aluminium. The importance, at the present time, of this light metal and light alloy industry is only second to iron and steel industry. Fortunately with the development of power and with the presence of bauxite in the country the prospects of this industry are very great as it is useful both in peace and war, so the Government must prepare a detailed plan for its manufacture. As the country has no other metal except iron and steel, it will be essential to replace many of these imported metals by the home made aluminium.

The Problem of Petrol. The experience of the last war shows that without petrol the condition of the country will be a very difficult one. Even now we are suffering from petrol rationing and all the road transport is being hampered due to limited supply of petrol. During the war there was great difficulty about the supply of kerosene and the poor class suffered terribly. In due course of time it may be possible to replace kerosene by electric light but the use of petrol for road or air transport is indispensable. India does not own any petrol deposit situated outside the country and has to depend upon foreign countries for its supply. So the question of petrol is very important from Indian point of view.

Recently during the question of developing the production of benzol as an alternative to petrol, it was stated by the Government that it will be considered. Every scientific man knows that benzol is produced from tar which is obtained from the distillation of coal. One ton of coal yields only a few pounds of tar and so the quantity of benzol obtained from coal in this way can only be very small. The chief product of coal distillation is coke, the demand for which is limited; and even under the most favourable conditions the amount of benzol produced can only meet a very small fraction of petrol consumption of the country. In other parts of the world there are big synthetic petrol plants, where even the highest octane value petrol can be manufactured out of coal. Germany fought the last war with a good deal of this synthetic petrol manufactured out of inferior quality coal. Before 1939 several plants were working in Europe and the capacity was much increased during the war time. The process has become a standard one. It requires roughly four or five tons of coal to make one ton of petrol. Besides that there is the cost of the depreciation of the plant and some labour. In

1939, just before the war the whole details of the plant as well as the cost of manufacture of petrol were worked out to the writer by Prof. Fischer and another amounting to -/4/- per gallon with coal at Rs. 4/- a ton in 1939. Now under the present price of coal at Rs. 15/- a ton the price of synthetic petrol will work out to about -/8/- per gallon which is lower than the price of the imported petrol. Besides its national importance it is quite an economic proposition to manufacture it at -/8/- a gallon. A 150 ton i.e. 45,000 gallons a day, or roughly 1½ crores gallons a year, is a good economic unit. The quotations for such a plant were about two crores of rupees in pre-war time or about Rs. 600/- per ton petrol capacity. It will be essential to have five or six such synthetic petrol plants scattered throughout the country, one or two in the Bihar coal fields, one in Central India Rewa coal fields and one in Singrani coal fields in Hyderabad State. Such 1½ crore gallon per annum plant will require two lacs tons of coal which is very small amount. The import of petrol in India before the war was about nine crores gallons. The future consumption might have gone up to eighteen crores gallons. Twelve synthetic petrol plants of 150 ton size will be able to make India self sufficient in petrol. The Bihar plant may be of 300 tons per day. The total coal required for making all this petrol will be about 25 lacs tons out of our total production of 2½ crore tons. The capital investment of all these plants may be 40 crores. America is very rich in petrol. Still in spite of that the United States is going to spend some crores of dollars during the next five or ten years for producing synthetic petrol and oil, according to a note from Washington dated 27th January 1948. As it will be a key industry, it will be worthwhile for the Government to own this industry. But if the policy of the Government be not to own the industries, in that case this industry can be handed over to private enterprise. But Government should give all foreign technical aid by establishing a pilot plant for testing our coal and making large scale trials.

Mineral Ownership and Taxation:—As far as the problems of mineral ownership and taxation are concerned a radical change is bound to take place. The abolition of zamindari throughout India is a near certainty which means abolition of the rights of the ownership of minerals in areas of permanent settlement like Bihar. Now the question of the right of the Centre or of the Provinces as to the ownership is of very great importance which needs a detailed consideration and solution, and it is expected that the problem may be dealt with in the new Constitution. The problem of ownership will also be intimately connected with the financial pro-

blem. The problem of mineral taxation is also one from the same series. These problems mostly depend upon the policy of the Government in power. So it is expected that most of these problems will be dealt in full detail in the new Constitution of Free India in the light of experience gained in other progressive countries of the world.

SUMMARY OF DEVELOPMENTS

Since the Sub-Committee of the National Planning Committee on Mining and Metallurgical Industries submitted its Report, great changes have occurred, mainly because of the War. Owing to the intense submarine campaign on the ocean routes; owing also to the occupation of all our foreign sources of supply in the production of war material for the Allies, the usual avenues for obtaining India's requirements by imports of Metals and Metalware were closed. On the other hand, the War needs of the Allies, particularly after the entry of Japan and the United States into the War, on either side, were urgent and imperative. India was an important base of operations for the forces in South East Asia, and as such every item of supply that could be had from this country was encouraged to be produced here to the utmost degree.

An intensive development of the industries rapidly followed. Under the Lease Lend System, America supplied our capital needs by way of plant and machinery to start these industries on a large scale in this country: and so a very considerable development took place, particularly as for war needs, price was no consideration, notwithstanding the operation of controls of all kinds.

As remarked elsewhere, before the War, the production of primary metals in this country was negligible, even in comparison to her own pre-war needs. Copper, Aluminium, Antimony and small quantities of Lead were the principal non-ferrous metals produced in India; and that production met hardly a fraction of the local demand. The annual imports of these goods aggregated some Rs. 12 crores.

During the War, and at the time the Industrial Panel on Non-Ferrous Metal Industries reported, we were producing:

Copper	6,000 tons, being 15% to 20% of our annual needs.
Aluminium from local Bauxite	800 tons, being 30% to 40 % of our annual needs.
Aluminium from imported Bauxite	1,600 tons
Antimony	250 tons being 75% of our annual needs.
Lead	100 tons being less than 1% of our needs

Even this increased production was unable to supply more than a fifth of our requirements. It is evident these requirements will be very considerably increased, if the plans

now being put forward for an all-round industrialisation of the country are carried out; if the programmes for electrification are realised. The needs of national defence would also make an increasing demand upon the industrial resources of the new Sovereign India since August 1947.

In addition to indigenous ore, or virgin metal, considerable room is available for the development of that industry from scrap. Before the War Japan produced considerable quantities of such metalware from scrap exported from this country, notwithstanding her own local sources of virgin metal. The War forced the Government of India to encourage Indian enterprise to build up these industries from the old metal, or scrap, which used previously to be exported. Despite difficulties of obtaining the requisite machinery, India was able to meet practically all the war demand for copper, aluminium or brass wires, sheets, rods etc., from this source supplementing the locally produced ore.

Emboldened by the wartime success, the entrepreneurs in this field have made large plans for developing this relatively new industry in the country in the post-war days; and they were fortified in making these plans by the implied, or express, assurance of Government to safeguard them against being driven out of existence, should the resumption of international competition after the War threaten them with such a fate. There are difficulties in their way for securing plant, equipment and machinery needed because of shortage in Dollar Exchange and shipping space. There is also the consideration that countries from which we may hope to meet our need for plant and machinery to develop these industries on a large scale are too busy meeting their own needs for making up the leeway caused by the War to attend to our requirements. Finally, the largest scale of operations, now planned for in these industries by Indian entrepreneurs, would not compare with a normal-sized competing producer of the same goods in the United States, or even in Britain. In competing, therefore, with these much more developed industries, the Indian producer is very much at a disadvantage; and unless effective and adequate protection is afforded in some way to the native industry, the hope of that industry developing to the degree where it can meet all our own demand, whether from locally produced virgin metal or from scrap, must be a very slender one.

This hope, however, is not without just basis. The Defence requirements of the country will make an ever increasing demand for the development of these industries, as also the Railways. Both of these are public concerns; and if both concentrate all their demand to be supplied from the local

industry, India would have an ample market to offer to her own enterprise in this field. Private industry developing under the Plan, and electrical expansion of the country would likewise offer additional demand, which could easily keep alive a fair sized industry on modern lines. Though not commonly classed as a "Key" industry, it is nevertheless of sufficient importance in defence and transport to deserve the most careful consideration and encouragement by the State. Says the Panel already referred to:—

> "It is obvious from a very brief survey of existing non-ferrous industries that up-to-date development has been meagre and import was the chief feature of the Metal Industry of India". (p. 8.)

After careful consideration of all relevant factors, the Panel came to certain conclusions regarding the lines on which post-war development of Metal and Mineral Industries should take place in India. Their suggestions regarding the development of individual Metal Industries are based on the general policy embodied in these principles; which it was considered would suffice to meet all the legitimate aspirations or requirements of this country seeking to achieve a balanced economy and national self-sufficiency as far as possible.

In the first place, the Panel recommend that a Government Department of Metal and Mineral Industries with a Minister-in-Charge should be established. At the present time (February 1948) a single Minister is in charge of Mines, Works and Power; but has no concern with metallurgical industry which is in the charge of the Minister of Industries proper. Even if we agree that these are unavoidable vagaries of Parliamentary Government, we must remember that this branch of industry is sufficiently important to deserve a separate co-ordinated ministerial charge by itself.

Within the Ministry, the Panel recommend the following sub-sections headed by a Director each:—

1. Geological Survey of India. This is absolutely necessary as the existing Survey is wholly out of date. Many developments and technical advances have occurred in the half century or more that has elapsed since the Survey was first made; and hence the need for a new Survey.
2. Department of Mines.
3. Department of Metals.
4. Mineral and Metal Research Bureau.
5. Fuels and Refractories Department. This has been recommended also by another Sub-Committee.
6. Such other Departments as are technically correlated to Mineral and Metal Industries.

Metals and Minerals Board. To assist the Minister-in-Charge of Metal and Mineral Industries, a Metals and Minerals Board should be formed, with the Minister-in-Charge as Chairman. Other members of this Board should be selected from Industrial Associations, the Geological Survey of India, the proposed National Metallurgical Laboratory, and such other associations and agencies, as are vitally interested in the development of metal and mineral industries of India.

The Metals and Minerals Board is intended to discuss and decide the policies to be adopted regarding the development of metal and mineral industries, such as control or prohibition of export of minerals; examination and revision of customs and mineral tariffs and taxation; granting mineral leases and prospecting licenses; proper utilisation of economic minerals, metals and their products; control of import and export of metals, desirability of starting new metal and mineral industries, etc. The Ministry of Metal and Mineral Industries, should execute the policies formulated by the Metals and Minerals Board.

As regards the fundamental policy for exploiting all known minerals, and exploring for new or additioanl sources, must, of course, be formulated by the Ministry concerned, approved by the Legislature, and carried out by Government. It is in this field that the question will have to be considered and decided if the mineral wealth of the country will be handed over to private enterprise to be developed, or whether it shall be treated as the country's heritage and so developed by collective enterprise. The importance of these industries in essential services like the defence of the country must necessarily demand nationalised operation of these industries from the start. The question as to whether any non-Indian would have any scope in this industry is now of minor importance, in view of the sovereign power being vested in the Ministers responsible to the chosen representatives of the people. No one would now question the desirability and necessity of reserving such initial gifts of nature to the children of the soil only.

Reorganisation of the Geological Survey of India. The first step in the development of non-ferrous metal industries should be in the direction of prospecting for ores and minerals. The Panel felt that the Geological services at present available for these purposes are absolutely inadequate. The staff of the Geological Survey of India is too meagre and ill-equipped to undertake, in addition to its routine work of survey and mapping, an intensive mineral survey and prospecting throughout India. An immediate and complete reorganisation of the Geological Survey of India and the estab-

lishment of a Mineral Survey Department—with adequate staff of competent geologists and mining engineers—to conduct intensive mineral investigations are thus absolutely necessary. We also recommend that the Geological Survey of India should have Regional Survey Officers in all the major Indian States and Provinces.

A properly organised and equipped Mineral Survey Department would be quite competent to provide technical advice and help to obtain equipment, instruments, etc., for Government who may also give financial help to private prospectors, if the prospects do not materialise into leases due to poor or insufficient quantities of ore deposits.

Expansion of Indian School of Mines, Dhanbad. It is evident that any systematic prospecting of a vast country like India will need a large staff of trained geologists and mining engineers. At present only 7 out of 17 Universities in India have prescribed Geology as an optional subject for their degree examinations, and only three institutions in India are offering courses in Mining or Metallurgy. The Panel have, therefore, recommended that the Universities should provide extensive courses in Geology, Mining and Metallurgical subjects, and that the Indian School of Mines, Dhanbad should be expanded and reorganised, so as to give not only intensive education in Mining, but also to make it the premier institution for training and research in Mining and Geology in all their various aspects. Mining, Geology and Metallurgical Departments should also be added to the proposed four higher Institutes of Technology to be established in India.

Central Bureau of Mines. A widely representative conference was held, in January 1947, under the presidency of the Minister for Mines, Works and Power, to consider the lines of national policy in regard to the development of Minerals in the country. At that Conference, there was complete unanimity about the urgent need of formulating a National Mineral Policy, and providing for Central co-ordination of Mineral development in all Provinces.

To achieve these aims, it was decided to establish, under the Government of India, a Central Bureau of Mines as early as possible. Its functions would be to collect information and statistics, organise training and research, formulate policy, and co-ordinate measures for conserving and utilising of the country's mineral wealth in her best interests. Government accepted the principle of this suggestion, and in the Budget for 1948-49, provided for a Central Bureau of Mines. The Bureau will act, in the initial years, as a Trust or an Advisory Body primarily. While it performs the functions of a Trust, or an Advisory Council, no executive power would be

vested in it; nor will it undertake any actual mining or marketing of minerals. The Bureau will, for the time being, function as an adviser on mining and marketing of minerals, and other problems that the existing organisations interested in mining and minerals may submit to it; or even new organisations which may hereafter be established to operate in this field. The financial provision in the 1948-49 Budget is made accordingly, on the basis of minimum immediate requirements, but if the new machinery is to act efficiently it will have soon to be considerably expanded.

Reduction of Freight Rates. The most serious disadvantage facing the proper development of the Mineral and Metallurgical industries of the country is the high cost of transport of raw materials within the country. India's mineral reserves are scattered over a wide area. For the purpose of manufacturing the raw materials available into a number of finished products, it is necessary to transport large quantities of heavy and bulky minerals and fuels over great distances. It has been calculated that it is necessary to move seven tons of raw materials to produce one ton of aluminium. On the other hand, freight rates on raw materials moved to the chief ports for export purposes are much lower than the freight rates on minerals which are being moved from mines to the smelters in India. For effective and rapid development of these industries the position should be reverse. Only one instance of comparative freight rates will suffice to prove that the cost of transportation is a great handicap to Indian industries. Ingot aluminium produced at Alwaye (in Travancore State) is rolled into sheets at Belur, Howrah. The freight rate for this distance of about 1,500 miles is Rs. 82/12/- per ton. This rate, it should be noted, is a preferential rate. In Canada the freight rate from the big smelting area at Arvida (Quebec) to Vancouver (British Columbia), a distance of about 3,000 miles is 19.00 dollars or Rs. 57/- per ton. Obviously the Indian rates are much too high. Government should, therefore, immediately consider the possibilities of these rates revision and their drastic reduction and adjustment on industrial raw materials and finished products. Such revision, reduction or readjustment would diminish in most cases the burden of tariffs, bounties or subsidies, which would otherwise be necessary to grant for protecting the industries while they are in private hands.

The possibilities of developing inland water and road transport for cheaper carriage of heavy and bulky articles like minerals will also have to be investigated. Transport is held responsible for a great deal of fall in production in 1946 and 1947. Not only are wagons not available, but the

service has become inefficient and grows costlier every year. Unless there is a readjustment and reallocation of the entire transportation work of the country between the several means of transport available—Road, Rail, Water or Air—this problem will not be solved. Another Sub-Committee of the National Planning Committee has considered this aspect of the question; and so we need not say more on the subject in this place beyond just adding that the recent policy of adding surcharge or increasing railway rates and fares to make up the Budgetary deficit is short-sighted, and likely to handicap needlessly the country's growing economy.

Control of Mineral Exports. As indicated in a previous chapter, India exports large quantities of minerals. In the vital interests of the country, it is imperative that no mineral should be exported without a compensatory return in the nature of much needed raw materials, machinery, skilled personnel, patent rights, etc. The Panel above referred to accordingly recommend that:—

1. Export of Beryl and ilmenite sands of Travancore should be stopped altogether.
2. Export of chromite, bauxite, manganese ores, etc. should be restricted, while domestic treatment of these ores or their whole or part manufacture before export should be encouraged.

Scope and Extent of Development of Non-ferrous Metal Industries. The Panel held that there was a vast scope for the development of non-ferrous metal industries in India, and so recommended that:—

(i) Those metals whose ores are found in sufficient quantities in India should be smelted locally under Government protection, if necessary.

(ii) Ores and other raw materials and virgin metals not available from Indian sources should be imported duty free.

(iii) All semi-manufacture and fabrication of finished articles should be done in India.

Ownership of Industry. On the essential organisational question of proprietary rights in the industry, this Panel made up largely of private entrepreneurs felt that ownership of semi-manufacturing and fabricating industries should be left entirely to private enterprise, except in cases where Government help is specifically solicited for special reasons. It is impossible to accept this recommendation in toto; but the policy of the present Government seems to be to leave as wide a scope to private enterprise as possible. With regard to industries producing virgin metals, which are not well established in India, the Panel recommend partial Govern-

ment ownership, which, however, may involve Government into needless loss. In the case of other metals production it might be necessary for the State to undertake the same. If a differential policy of this kind is to be enforced in one and the same group of industries, the State may be needlessly saddled by those enterprises which are bound to be losing for a number of years, while the profitable minerals, metals and their working up may be monopolised by private profit seekers.

Capital Requirements. With respect to semi-manufacturing and fabricating industries, the Panel held that sufficient capital would be available through private investment. They added, however, that it might be necessary for the State to finance in part or wholly the production of some of the virgin metals. Financing of mining ventures is, however, generally admitted to be a risky business, where there would be some hope of making up the losses on the round abouts by the gains on the swing, if the entire mechanism was in the same hands. There is, besides, much more likelihood of speculation if any part of the Mining and Metallurgical industry was in the hands of private individuals or corporations. It would, therefore, be desirable to reserve the entire field for capital financing for mining ventures and metallurgical industries in the hands of the State. The recent proposal to establish an Industrial Finance Corporation, a semi-public body, would be of great service in this regard.

Technical Advice...Our lack of experienced technicians is undeniable. Expert technical advice from abroad would be necessary in the initial stages of starting new industries. Since 1945 Government have been encouraging and assisting qualified students to go abroad for technical training. But there is yet no proper arrangement to provide them with employment when they return. Unless and until a proper National Plan is made, this problem of finding prompt and appropriate employment for Indian trained and experienced technicians will not be satisfactorily solved. These trainees on their return should be able to replace the technical personnel recruited from abroad in the initial stage of development. In view of the recommendation that the Indian Railways should greatly increase the use of light metals for locomotives and coach construction, as well as for fittings etc. a number of Indian metallurgists and engineers would be sent from the Railways to the U.K. and U.S.A. to acquaint themselves with the latest development and technique for the utilisation of light metals in Railways.

Co-operation with Foreign Firms. One of the great handicaps of the Indian industry in this field is that it has

no patent on devices, processes or material needed in building up the industry. The Panel above referred to have accordingly suggested that co-operation with foreign firms regarding patent rights, technical help, etc. should be welcomed. They also hold the view that foreign participation in capital should be discouraged as far as possible, and should be limited to the extent of 30% to 40% only, in cases where participation in capital is made a condition precedent to the co-operation solicited, or where the help needed is not available from any other source without participation in capital. The chances of Government purchase of such rights are also not negligible. But whether Government take over these patent rights from foreign holders of such rights, or foreign capital participates in the development of the industry, its management should remain entirely in Indian hands. In a properly planned national economy, Government control in either case will have to be very considerable.

Location of Industries. The Panel believed that the location of these industries in most cases would depend upon the availability of raw materials, power, labour, suitable freight rates, defence considerations, markets, etc. They nevertheless recommended that fabricating industries should be decentralised as far as possible, subject to the production unit being economic. The final decision should be such as to fit in with the overall plan; but in deciding each case the factor of railroad freight or other transport charges will have to be fully allowed for. If the ambitions of India for rapid industrialisation are to be realised, her Transport Service will have to offer much more economic rates than prevail today.

Government Assistance to Industries. So long and in such proportions as this essential industry remains in private hands, some form of Government protection or assistance would be unavoidable. Such aid can only be given at the expense of the tax-payer. The Planning Authority will, therefore, have to give the closest consideration whether from the very start, when there are no vested interests, this group of industries should not be entirely State enterprise, owned, manned and controlled by Government in the interests of the country as a whole. If, however, despite this consideration, the industry is allowed to be in private hands, the Panel suggest the following ways and means of giving that protection:—

(i) Lifting of all import duties on scrap metals, on raw materials, and virgin metals.

(ii) Giving subsidies to high cost producers of virgin metals, like copper, aluminium, and antimony, who have to compete with cheap imported metals.

(iii) Levying import duties on semi-manufactures and finished goods to protect Indian industries.

(iv) Lowering of inland freight rates and providing better transport facilities.

(v) Purchasing all the Government Stores required for railways, ordnance factories, telegraph and telephone, etc. of Indian manufacture, unless the articles required are not manufactured or could not be easily manufactured in India.

(vi) Making available to the industry the services of expert personnel in the Planning and Development and other Departments of the Government of India.

(vii) Making available to the industry the services of the proposed National Research Laboratories.

(viii) Giving financial and technical help to private prospectors.

Government Controls. Such assistance could not, however, be given without some sort of *quid pro quo*. Even the Panel had to recognise that some measure of Government control of the non-ferrous metals industries would be necessary to achieve production targets set from time to time and to limit excessive profits of private capitalist owners. In cases where assistance is granted to the industry, in some form or another, suitable controls will be necessary to see that the assistance is not misused. In general the Panel considered the policies outlined in the "Statement of Government's Industrial Policy" to be quite adequate. The recently appointed Tariff Board is implementing that policy wherever cases have come before it for the purpose.

Organisation of Different Units of Industry. For facilitating control and supervision, as well as for effecting all possible economies in building up the industries, the Panel recommend that the different units of the industry should be organised in one or more Industrial Associations. These organisations should comprise all branches of the industry, like producers of virgin and secondary metals, semi-manufacturers, fabricators, etc. and should have a unified policy to enable them to express the sentiments of the industry as a whole. This, however, does not mean Cartelisation of the industry, which the Panel consider to be undesirable and should not be allowed to develop. The organisation of the Labour engaged in this industry, and the necessity of collective bargaining are not even mentioned by them; but these are no less important.

Stages of Development. The first step towards the development of industries producing virgin metals should be in

the direction of a comprehensive prospecting for metallic minerals and ores, and determination of ore reserves in India. This would be part of the work of Geological Survey already suggested. The deposits which have already been discovered should be further prospected. This should be followed by providing adequate facilities for power, transport of raw materials, etc. The final stage would be the actual erection of plants at suitable sites for reduction of ores. Possibilities of reducing imported ores should also be looked into.

Cheap power is the pre-requisite of all industries, but particularly in this group. The recently introduced Electricity Rationalisaton Bill seeks to generate as well as control electric power. Various power projects, contemplated for different regions on the recommendation of the Central Technical Power Board, have to be duly advertised, and requirements of industries registered beforehand. This will enable the promoters of new industries to decide upon the most suitable location and start metal and mineral industries with some confidence. The money and energy devoted to the building up of these great hydro-electric projects would be wasted, if industries are not simultaneously developed to consume that power.

Export Market. India's own need for these products is so great, that for a long number of years, there can be little hope of developing an export market for these wares. The Panel suggest export markets should be developed only for those metallic manufactures, which can be produced in abundance—more than enough to meet the steadily expanding local demand—without unnecessarily depleting the country's ore reserves or affecting the country's markets.

Cottage Industries. It is difficult to conceive the manufacture of metals on a cottage industry basis. However, the final fabrication of metallic products could be encouraged by the "Cottage Industries." The Panel, therefore, recommend that such industries should be run on a co-operative basis; and all possible help should be given to them in the nature of cheap power and raw materials, technical advice and literature, machinery, training of workers, etc. The best scope for metalware to be produced on a cottage-industry scale would be in the artistic designs with great craftsmanship which Indian artisans have been famous for centuries in producing.

Capital Goods. The Panel recommend that all import duties on capital goods should be removed, until such time as India could manufacture her own requirements. Every facility must likewise be afforded for imports of capital goods from countries where they are readily available, e.g. shipping

space or adequate exchange. Capital goods which can, however, be manufactured locally should not be allowed to be imported. At the time the Panel reported, it was obvious that there would be a good deal of surplus equipment available from war plants of the United States, Germany and Japan, which might well be obtained to meet Indian needs. Before, therefore, ordering new equipment, enquiries should be made as to the availability of this surplus equipment. There will also be some surplus equipment available from Indian Ordnance Factories, particularly the Ambernath and Katni Ordnance Factories, which should be leased or sold to established non-ferrous metal manufacturers, if such equipment can be used by them. If, Government have any surplus of this kind, their intention as to the disposal or utilisation of the existing non-ferrous processing ordnance plants, whch may be surplus, must be clarified as early as possible to avoid duplication of plants by imports.

Indian Standard Specifications. At present there are no adequate and comprehensive specifications for the guidance of manufacturers and buyers of metals and alloys. It is, therefore, necessary to co-ordinate Indian Railway and Ordnance specifications under one schedule. The Panel, accordingly, recommend that Government should appoint a Committee to devise Indian Standard Specifications for metals and alloys, and that all Government Departments and industrial concerns should exclusively follow these specifications when devised. This recommendation has been endorsed by a number of other expert bodies, and is likely soon to be acted upon.

Industrial Deputation. The Panel expressed the opinion that before any large scale plans for the development of Non-Ferrous Industries of India are undertaken, a deputation of metallurgists, industrialists, technicians, and others connected with and interested in the development of such industries should be sent to the U.K., U.S.A., Germany and Japan with Government assistance, to study the latest developments and technique of metal production. In the modern competitive era, it is absolutely essential that the industry should be in the closest touch with new developments, and full advantage should be taken of the technical advances made during the war to develop Indian industries on modern lines. Two deputations of this kind visited Europe and America in 1945 and 1946; but the results have yet to be taken advantage of.

Transition Period. The Panel were of opinion that Government control on non-ferrous metals should be relaxed gradually, and re-modelled during the transition period. There is bound to be a large civilian demand for all kinds of

goods in the period immediately following the war. Government must, therefore, do everything in its power to see that foreign competition is not allowed to capture the Indian market. The formation and deliberations of a permanent Tariff Board to revise and modify the present tariff rates on imports will take some time; and so the Panel proposed that in the interim period Government should continue to give support to the non-ferrous industry as was done during the War. Such a Tariff Board was also recommended by the Planning Advisory Board, which reported early in 1947. The *ad hoc* Tariff Board appointed in 1945 continues the work; but it is to be hoped the Board will soon be placed on a permanent footing.

Recommendations. The Panel made certain specific recommendations which may briefly be summarised as follows:—

(1) The scrap metals in Government stocks should not be auctioned but distributed to established refiners and semi-manufacturers according to the capacities of their plants.
(2) Government should not issue licenses for import of metals without consulting representatives of Indian Non-Ferrous industrial and commercial interests and only such quantities of metals as are likely to be required in excess of indigenous production should be allowed to be imported.
(3) Facilities should be provided for duty free imports of scrap metals and capital goods from countries where they are readily available.
(4) Export of scrap metals should be regulated.
(5) Government should instruct their Purchase Departments to extend their purchase preference to products manufactured by Indian industry.
(6) No long term orders for materials required for post-war plans of railway expansion, power development etc. should be placed in foreign countries, unless it is found on investigations that such materials will not be produced in India in the near future.

The case of Iron and Steel has been dealt with in the Report of the Sub-Committee on Engineering Industries; that of Coal, in the Report on Power and Fuel; and of Salt in the volume on Chemical Industries. The second Report, however, of the Iron and Steel (Major) Panel, (presented in Sept.) contain recommendations, which it is necessary to summarise to give a fuller picture of the Developments that have taken place since this Sub-Committee reported.

The question of the Rolling Mills did not form part of the original special Directive to the Panel; but the following clause was added subsequently:—"To consider the question of the place of the Rolling Industry in the future, and to make such recommendations as may be deemed necessary for the reorganisation and rationalisation of the re-rollers."

"We have traced the origin and growth of the Re-rolling Industry which dates practically from the Tariff Board's Report of 1933-34. We are satisfied that there is nothing in the Report which established an unqualified claim on its part to a recognised place in the Steel Industry as a whole.

"Our own investigations have shown that the industry as it operates at present has not been able to put forward a case which would justify its claim to be recognised as a useful contributor towards the expansion of the steel industry. In order to do so it must take steps to put its house in order by fulfilling the following conditions which without being exhaustive are indispensable, viz. :—

(i) It must be organised on sound lines by elimination of those units the existence of which cannot be justified on reasonably economic grounds or which are in excess of the numbers required to meet adequately the demand for their products.

(ii) (a) It must be properly equipped, adequately financed and efficiently managed—efficiency being judged by the works costs and its utility, by the age and the nature of the plant.

(b) It should roll special products which are required in relatively small quantities for special purpose and which cannot be more economically produced and distributed by the bulk production units, having proper regard for the location of the markets to be served.

(iii) The basic price expected for these products should bear close relation to the basic price payable to a major unit of the same class for similar products and should conform to a list of extras for size and service.

"It was arranged in April, 1945 that an expert was to be invited to visit India and to report on the re-equipment and re-organsation of the Industry. The expert arrived in January, 1946. He has not been able to complete and submit his report and we are unable to make any proposals as to how and to what extent the industry needs re-equipment and reorganisation.

"In the meanwhile we believe that there are grounds for recommending that in a well-organised industry there is a

place for re-rolling mills which fulfil the conditions mentioned in paragraph 99 and take such measures as may be found to be necessary to improve their efficiency.

"We, therefore, limit our recommendations to the assistance which may be accorded to them on the assumption that they have taken the necessary steps to qualify themselves for receiving such assistance and have fulfilled the conditions set out in paragraph 99.

"*Supply of Billets:*—After the Re-rolling Mills have been reorganised and fulfilled the conditions mentioned in paragraph 99 the supply of billets to them should be governed by the following considerations, viz. :—

(i) In order to achieve the lowest costs no major works or other producing units is expected to use in other than exceptional or particular circumstances any steel for rolling billets or other semis if any of their finishing mills are thereby prevented from working to maximum capacity.

(ii) Billets or semis when available to be supplied in the following order or priority:—

(a) Those units which were built before the war on an express or implied agreement or understanding that they would be provided with those materials by any of the existing works, or when leased or controlled by such works, the products rolled by the unit being sold as the property of such works.

(b) Those units which were started during the war and to the products of which protection is or may be granted by the Temporary Tariff Board.

(c) Those of the reorganised units which by their situation in the interior have no economic alternate source of supply.

(d) Those units which were established at the ports and were operating before the war without any expectation that billets will be supplied by the local works and had built their business on imported material and at whose instance and for whose benefit imported billets were admitted free of duty.

"*Engineering Industries:*—The industrial expansion generally in India during the period between World Wars I and II has been small in extent and slow. It has not been sufficiently advanced to justify the manufacture of specialised engineering products from iron and steel which could more readily and cheaply be imported.

Prior to 1940 the Engineering Industry consisted of a hundred or more firms representing the principal undertakings other than those owned by Government. The activities

of these firms were in most cases confined to general jobbing work rather than to specialised production.

A high standard of workmanship and efficiency has been reached during the past fifteen years in the case of a few of the secondary industries manufacturing from iron and/or steel.

The inflated demands following World War I led to the establishment in India of a structural Fabricating Industry with a capacity in excess of requirements in subsequent years. For several years prior to the outbreak of World War II Structural Workshops operated at between 1/2 and 1/3rd of their full capacities due to lack of demand for structural steel work.

"*Structural Engineering Industry*:—In order to maintain the Structural Industry in a healthy condition, it is recommended that the Central and Provincial Governments should accelerate the execution of their Post-War Programmes for capital works which will absorb fabricated steel-work.

The Structural Fabricators generally have expressed willingness to expand their existing capacities as soon as there are prospects of an increase in the demand for bridge and other structural steel work. It is, however, also recommended to the Industry that it should re-organise itself by improving works layouts and modernising its plant and equipment so as to be in a position efficiently to meet the future demands which may be made upon it.

"*The Wagon Building Industry*:—The capacity of the Wagon Building Industry is considerably in excess of the anticipated demands for goods rolling stock during the next few years. There appears to be no justification in recommending any expansion in this industry until the surplus capacity has been absorbed. The industry has intimated that it is undertaking the modernisation of its equipment which will, besides increasing the efficiency of the fabricating units, increase the wagon building capacity.

"*Iron Casting*:—The demand for accurate iron castings to a uniform analysis depends largely upon the development of India's secondary industries. The establishment of Mechanised Foundries is, however, being undertaken and plans are being completed for an increase in the production capacity of high duty iron castings. It is therefore anticipated that the Iron Castings Industry should be in a position to meet demands which may be made upon it as secondary industries develop.

"*Steel Castings*:—The capacity of the Steel Castings Industry has increased by 50% since the beginning of World War II. Two-thirds of its output is consumed by the Railways,

but here again, any appreciable increase in demands for steel castings will depend to a large extent on the development of secondary industries. The provision of additional machining facilites must be made available for machining castings to fine limits when an increased demand materialises.

"*Steel forgings*:—It is considered that specialised forging units should be established to supply industrial units engaged in the production of locomotives, ships, marine engines, etc., as and when such industries come into being, in preference to the establishment of heavy forging equipment in the units actually producing such manufactures. Again, it is anticipated that there will be a future demand for Agricultural Machinery and should this evolve on an extensive scale an increase in the existing forging equipment will be warranted.

"It is recommended with a view to avoiding an unduly high capital burden that in future planning the establishment of self-contained units in each industry be discouraged in favour of the establishment of a minimum number of modern units for the production of heavy and light steel pressings, castings, and forgings which would feed all other industries with these commodities. It is also considered that the establishment of these specialised production units under private enterprise should be encouraged.

"*Alloy, Tool and Special Steels*:—The manufacture of Alloy, Tool and Special Steels has developed in other countries of the world, with the growth of the Machine Tools and Machinery Manufacturing Industries. Hence the development of these categories of steel in this country would also depend on the simultaneous growth of the Machine Tool and Machinery Manufacturing Industries.

"The consumption of these special steels in this country has been small and has in consequence been imported from abroad. The available data for ascertaining the imports are also inadequate and unreliable. It is, however, essential to develop the production of these special steels as a necessary requisite for the manufacture of machine tools and industrial machinery for the following reasons.:

(a) to meet the needs of India's growing industries, such as the manufacture of automobiles, locomotives, aircraft, machine tools, etc.;

(b) to provide a higher level of self-sufficiency and to make India less dependent on foreign sources of supply;

(c) to provide an outlet for the utilisation of indigenous alloying elements; and

(d) for armament purposes.

"On the outbreak of the war owing to the more or less complete cessation of import of these categories of steel and owing to their mounting demand for armament production, the manufacture of Alloy, Tool and Special Steels was taken up by the Tata Iron & Steel Co., Ltd., at the instance of the Government. As a result of this war time necessity a large variety of Alloy, Tool and Special Steels including high speed steels, stainless steels, aircraft steel to E.N. specification, bullet proof steel, drill steel, etc., were manufactured.

"It is particularly difficult to form an estimate of the post-war demand for these steels. We ourselves have not been able to secure any data to make an estimate of the present and post-war demands of these steels. But according to an estimate given to us by the Tata Iron & Steel Co., Ltd., these demands for the various categories of special steels may be put down at anything between 6,000/8,500 tons per annum, of which we might require within the first five years about 350 tons of high speed steels, about 200/300 tons of stainless steels, about 2,000/3,000 tons of alloy steels, about 3,000/4,000 tons of carbon tool steels, and about 1,000 tons of drill steels.

"We are of opinion that the production of Alloy, Tool and Special Steels is a highly skilled operation and apart from the steel melting facilities, it requires a large variety of specialised equipment such as ingot dressing equipment, forging presses, specially designed slow rolling mills, heat treatment furnaces, finishing and inspection equipment etc., besides highly qualified technical personnel.

"In our opinion, therefore, it is very essential that the manufacture of these special steels be concentrated in the plants of the primary producers. In expressing this opinion we do not wish it to be conveyed that a monopoly in the manufacture of these special steels should be created and no other manufacturer should take up their production if he has the necessary equipment and experience to do so.

"In view of the fact that only a small quantity of such special steels will be required in the immediate post-war period and of the enormous expenditure involved in the specialised equipment required for the purpose, the production of these steels in the smaller works should proceed with caution. We have very little evidence to express an opinion as to whether their production should be restricted to one or two primary producers or should be generally permitted. But we feel that it would be undesirable at the moment for the small producers, having electric furnaces for the manufacture of steel castings, to take up the production of these specialised products.

"In the production of these special steels such alloying elements as Aluminium, Manganese, Chromium, Cobalt, Nickel, Molybdenum, Tungsten, Titanium and Vanadium are required. Considering their small quantity it may be necessary for us to import some of them from foreign countries. It is therefore suggested that with a view to encourage the development of these special steels as a preliminary step to establish the more important Machine Tool and Industrial Machinery Manufacturing industries in this country the import of these alloying elements should be allowed free of duty for this specific purpose."

These recommendations still await being given effect to. In the years following the War; and particularly after the cessation of the intensive drive for increased production to meet insatiate war demands, the output in these industries has fallen seriously. The problem today is, accordingly, to restore production level to at least what it was under the impetus of War demand. Various explanations are assigned for the decline in production,—e.g. Labour unrest and frequent strikes; high taxation reducing incentive for increased production; fall in demand due to disappearance of the war needs; but none of these by itself can explain the steep fall in production that has occurred. The question is viewed by different parties according each to its own interests and preconceptions; but none see the matter in the proper perspective of a Planner, viewing this industry as an integral and co-ordinated part of the National Plan for a simultaneous, comprehensive, allround development of all available resources to meet known needs of the country, and so bring about a balanced economy, and a degree of National Self-Sufficiency, which, in these days when war drums are still beating, must not be ignored on pain of national annihilation.

The Industrial Policy of Government, recently announced, has gone against many of the recommendations of the Planning Committee as a whole; and, in places, even against the letter and spirit of the Panel recommendations made when India was under alien rule. The present Government seem obsessed with the worship of practicability; and as such, have announced an Industrial Policy which does not take stock of the entire national economy, and seek to meet its needs by a correspondingly comprehensive, co-ordinated National Plan.

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