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SECTORAL STUDIES PREPARED FOR THE SYMPOSIUM

IRON ORE INDUSTRY

Presented by the Secretariat of the
United Nations Economic Commission for Europe

67-15316

Contents

Annex

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Recent developments and principal problems

1. The iron ore industry[1] has during the past two decades undergone considerable change, not only in technology applied in mining and processing iron ore, but also in its structure and in the product and geographical pattern of its output. This is only partly due to developments which arise in the industry itself; the main causes for such changes stem from the fact that its products (mainly iron ores of different qualities, i.e. a large variety of physical forms and chemical composition) are used by one other industry only, namely in the production of iron and steel. Therefore, the fluctuations in the market for iton and steel products and the growth of this industry have always had a strong impact on the development of the iron ore industry.

2. Since iron and steel products are, economically speaking, semi-finished products, demand for which depends on the growth of the economy in general or of specific industrial sectors, it would appear that any fluctuation in the market for finished iron or steel containing manufactured goods, leading to fluctuations in the demand for and output of finished iron and steel products, will create still larger fluctuations for iron ore production; these flucutations depend in their amplitude on the considerable quantities of ore kept as stocks, e.g. at mines, at loading port, in transport, at unloading ports, at works, and they may be increased by the alternative use of iron and steel scrap, the other principal source of iron for crude steel production.

3. The actual situation of the industry reviewed in this paper can be described as one of over capacity at mines facing a demand which has - for reasons inherent in the iron and steel market - during the past few years shown signs of slackening, at least in those countries which are the principal importers of rich iron ores. It is difficult to assess, even in a more detailed study than the present, the extent to which factors arising in the mining industry itself or in

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1/ For the purposes of this paper, this industry has been defined to comprise the mining of ore and its preparation (e.g. mining, grading, treating, blending, concentration and agglomeration into sinter, pellets etc.) for smelting in blast furnaces (or any other pig-iron making installation) as used in crude steel-making as a de-oxydizing agent.

the iron and steel industry are the cause of the present situation. However, a number of factors are clearly discernible; they are set out in the following.

4. The iron and steel industries in the industrialized countries were set up on or near local iron ore (and coal) resources, and iron ore mining was for many decades confined to the areas close to the ore consumption centres. When, however, local resources were nearing depletion, ore became, even in comparison with rather distant sources of iron ore, too expensive to exploit, private firms, the State and international bodies undertook large-scale exploration of the world's iron ore resources. The subsequent development of new mines for the production of rich iron ores remained largely in the hands of the consumers of ore who were ready to accept the risks inherent in a mining operation in, sometimes, untried areas, provided their supply of ore was assured and their iron and steel production costs were maintained. This led to the opening of mines in the developing countries and brought thus a considerable change in the geographical pattern of iron ore output. These new mines were in most cases, so-called "captive" or "semi-captive" mines, where the capital invested is in whole or in part subscribed by ore consumers and/or which have undertaken legally to sell all, or a substantial part, of their output to these ore consumers, thus ensuring that they have the minimum sales to subsist.

5. These developments were also encouraged by the Governments concerned, many of which--such as India and Liberia--had endeavoured to attract mining interests even before the Second World War. Moreover, as the economics of this new pattern of trade became more assured and as the techniques of exploration, mining, and transport developed, the Governments of many of the new iron ore countries decided, in order to safeguard the interests of their country, to invest public funds to develop the domestic iron ore resources, first, as an export industry, and later as the basis for a national iron and steel industry.

6. During and after the Second World War, considerable advances had been made in ore preparation techniques, i.e. in methods designed to up-grade ores of lower Fe-content and to use ore fines (arising in transport, in beneficiation or as natural fines) in the production of agglomerates like sinter and pellets. Since technical progress in mining and transport had also been considerable, a

number of lower grade ore bodies became economic to mine: a new iron-mining industry developed, mainly in the United States, Southern Labrador, the USSR, Sweden, but also in some of the developing countries. Their output capacity appeared as a welcome addition to existing sources on the international market.

7. Turning now to the development of demand for iron ore, a number of points concerning trends in the iron and steel industry and its market are set out below, in order to show their impact on the world market for iron ore. When the backlog in demand for steel-containing-consumers' durables arising out of the war, together with reconstruction requirements, brought a spurt in steel demand during the years immediately after the war, the iron and steel industry met this situation by expanding mainly crude-steel making and steel-rolling capacity, instead of expanding blast-furnace capacity proportionately and, hence, demand for iron ore, use was made of ample and low-price availabilities of war-time scrap, used in steel making.

8. When, however, the Korean crisis brought record demand for steel, which, moreover, proved in the ensuing years to be of a more lasting nature, the policy of iron and steel-makers underwent a change in so far as the stress was put now on building of and research on blast-furnaces. This tendency was further promoted by the fact that scrap started to become scarcer and more expensive. At the same time, both technical and economic research had shown that larger instruments of production were the most economic to operate (in a market of corresponding size), and hence there was a trend towards building very large blast-furnaces of much increased productivity. An important element in blast-furnace productivity is, of course, the use of a well-prepared burden and use of higher-grade ores; therefore, iron and steel producers in Western Europe, the United States and Japan were led to provide for the future a steady flow of high-grade ores from overseas which, in many cases, replaced depleted or high-cost domestic sources and led to the development of "captive" or "semi-captive" mines mentioned further above. As steel demand continued to increase, iron ore prices reached a rather high level, with a peak in 1957.

9. This relative shortage of rich ore and the high level of world market prices had induced a considerable amount of investment, also from other sources than the consumers of the iron ore. A number of new rich ore mines were developed, all coming into production at the end of the 1950's or during the early 1960's. However, the situation of the steel market in some of the principal consuming and producing countries (which are also among the main importers of iron ore) changed, after 1957, from a "buyers" into a "sellers" market: the sustained growth of steel demand had led to large capacity expansion which brought fierce competition, first in the world market for steel and, later on, also on the home markets of some of the main producers. One of the results of this was a decrease in the rate of growth of steel output and, particularly, of pig-iron output or demand for iron ore: pig-iron output in the principal ore importing countries taken together (ECSC, Japan, the United Kingdom and the United States) had, between 1950 and 1957, grown at an annual (compound) rate of 5.15 per cent, whereas growth was only 3.9 per cent between 1957 and 1964. The consequence was a fall in the world market price for iron ore. Swedish ores (Kiruna D, c.i.f. Rotterdam), which reflect very well the general development, in 1964 were 26 per cent cheaper than in 1957. Average import prices of ores into the United Kingdom in 1964 were 22 per cent below their 1957 level.

10. This development of ore prices illustrates very well the present state of the market which is still characterized by an over-capacity for exports of rich ores, situated in particular in developing countries. The actual level of f.o.b. prices for iron ores exported from these countries was, in some cases, less depressed than c.i.f. prices in the principal consuming centres, since freight rates for iron ores had fallen slightly.

11. All these changes had their effect on the iron ore industry. In the industrialized countries, the relatively low-grade ores difficult to beneficiate, on which the original iron and steel industries were established, are increasingly threatened. They are to some extent protected by the fact that considerable capital investment has grown up around them, frequently in areas where inland transport still renders the delivery of imported ore uneconomic; but the

mining industry in these countries is obliged to "rationalize" itself, closing down mines producing too low a grade or at too high a cost, improving mining techniques and, wherever possible, preparing the run-off mine ores. These home industries may subsist during the foreseeable future but their contribution to total Fe-requirements in their country is diminishing as imported rich ores replace use of low-grade home ores in existing plants or in new plants built on the sea coast.

12. The situation has also changed for some of the traditional suppliers of iron ores. Some mines, well-established between the two wars, are now experiencing difficulties to find a market at adequate prices; they are trying to reduce their costs and to improve the quality of their product. Even Sweden, the oldest established international supplier of iron ore, is paying ever-increasing attention to ore-grading, concentrating and pelletizing and has, furthermore, recently modernized its ports and railways.

13. As far as the developing countries are concerned, the opening-up of new mines in the post-war period to satisfy the demand of the industrialised countries and of their nascent steel industries for high-grade ores, has been a beneficial development which has helped to improve their foreign exchange position, to alleviate their unemployment and to provide a nucleus for economic and industrial development. However, the present situation of over-capacity for iron ore mining and rich ore exports, and the corresponding fall in world market prices has somewhat reduced the beneficial effect the establishment of an iron ore industry has had on the economics in developing countries.

CHARACTERISTICS OF THE SECTOR: BRIEF DESCRIPTION OF THE IRON ORE INDUSTRY AND ITS MARKET

Situation of supply

14. World iron ore resources are at present estimated to amount to some 250,000 million tons of reserves and a further 200,000 million tons of inventoried potential resources which, taken together, contain about 200,000 million tons of metallic iron. These figures are of course subject to revision, as further exploration proceeds and adds new workable reserves to the list; further additions may be made to reserves if changing economic and technical conditions permit for the classification of potential resources as reserves. It is also possible that one or the other deposit, particularly of low grade ore, may have to be deducted from the list of reserves if the economic conditions prevailing at a given point of time limit mining to the richest parts of such deposits.

15. The geographical distribution of "reserves" and "potential resources" is illustrated by the following data (in millions of tons).

Region	Reserves	Potential Resources
Western Europe	20	5
Eastern Europe	104	14
Total Europe	124	19
North America	53	93
South America	50	42
Total America	103	135
Africa	13	14
Asia	8	29
Oceania	8	7
TOTAL WORLD	256	204

The largest reserves of iron ore are in such countries as the USSR, the United States, Canada, India, Brazil etc., and it would appear that their extent is

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adequately known, although some of those situated in more remote areas may become economic to exploit as industrial potential and communication networks are further developed. Increases in resources and reserves can be expected to take place in the new countries of Asia and Africa and in the so far undeveloped areas of South America, Australia and China (Mainland). It is evident that, if iron ore use develops at about the same pace as in the last 10 years (at about 5 per cent per annum), even presently known reserves will be sufficient to meet demand for decades to come; this does, of course, not obviate the necessity of further mining exploration and development during this period.

16. Between 1937 and 1964 world iron ore production increased from 220 million tons to 600 million tons. The figures given in Table 1 (annexed) show the distribution by regions of the quantities of ore produced (in thousands of tons, actual tonnage). The development of production in terms of iron contained in the ores is illustrated by the data in Table 2 (in thousands of tons, Fe-content).

17. The data (particularly those on Fe-content in ore produced) bring out the increasing importance of the iron mining industry of Latin America, Africa and Asia, but also of the USSR (providing most of the tonnage shown under "Eastern Europe"). The principal changes in the geographical pattern of world iron ore production are further illustrated by the following percentages for 1937 and 1964 (based on Fe-content):

Region	1937	1964
Western Europe	33.6	17.6
Eastern Europe	16.7	29.2
Total Europe	50.3	46.8
North America	36.5	22.8
South America	1.4	10.2
Total America	39.9	33.0
Africa	3.4	6.5
Asia	5.2	12.4
Oceania	1.2	1.3
WORLD TOTAL	100.0	100.0

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It will be seen that Western Europe and North America have lost in significance, whereas Eastern Europe and the new mines in the developing regions have increased their proportion of world output considerably. Western Europe and North America would be still less important were it not for Sweden and Canada, where iron ore mining has made great progress in the course of the last 30 years. This is also shown by the following data on iron ore output (Fe-content) of the most important producing countries in 1937 and in 1964 (thousands of tons and percentages).

18. Together with this change in the regional pattern of iron ore output, an increase in iron-content of marketable ores has taken place, the reasons being the improvement of iron ore preparation techniques and installation at the mines; the closing down or the slower growth of output in a number of low grade ore mines, particularly in Western Europe; the generally longer shipping distances (which promote a tendency towards transporting more iron per ton of crude ore); and in general, the discovery and exploitation of richer ore bodies in the new iron mining countries. The demand side, i.e. in the iron and steel industry, shows a strong drive towards increasing productivity in general and in blast-furnace in particular; one of the means to achieve this is, of course, the use of richer ores.

The trend and pattern of consumption

19. Between 1937 and 1964, world steel production rose from 138 million tons to 434 million tons a year. Since pig-iron requirements for other than steel-making purposes (i.e. mainly for iron foundries) rose during the same period from 19 million tons to over 30 million tons a year, total demand for Fe-bearing materials increased from 150 million tons in 1937 to 470 million tons in 1964, or to three times the initial level. Demand for iron ore was, however, not affected to the same extent since, as was mentioned already, iron and steel scrap is used as a substitute for pig-iron in steel-making vessels. The extent of scrap use is largely dependent on its price, both in relation to pig-iron prices and to the steel market situation, and on certain technical factors, which may limit the amount of scrap used in different types of steel-making vessels. This explains also the fact that in 1937 world requirements could be met by producing

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218 million tons of ore containing aaproximately 98 million tons of iron (i.e. 65 per cent of the 150 million tons of crude steel and foundry iron produced that year), whereas in 1964 world iron ore production was about 580 million tons of ore with 290 million tons of iron, i.e. little more than 60 per cent of the 470 million tons of metal produced.

20. The geographical pattern of iron ore consumption is almost identical to the distribution of iron and steel-making industries. The following data on pig-iron (and ferro-alloy) production give an impression of the geographical pattern of iron ore use (percentages of world production; figures in brackets give the share each country holds in world iron ore production, Fe-content):

Country	1937		1964	
United States	38.6	(37.6)	24.8	(15.6)
USSR	12.9	(15.6)	19.3	(28.1)
Western Germany	12.7	(2.8)	8.6	(1.0)
Japan	4.2	(0.3)	7.6	(0.5)
United Kingdom	9.6	(4.4)	5.6	(1.5)
France	5.7	(11.7)	4.9	(6.4)
Belgium-Luxembourg	4.6	(2.4)	3.9	(0.6)
Czechoslovakia	1.7	(0.6)	1.8	(0.3)
Poland	1.1	(0.3)	1.7	(0.3)
Italy	1.5	(0.5)	1.1	(0.2)
Other countries	7.4	(23.8)	10.7	(45.5)
WORLD TOTAL	100.0	(100.0)	100.0	(100.0)

It will be seen that there is a slight change in so far as the rapid development of iron-making in Eastern European countries, particularly in the USSR, and in Japan have decreased the shares held by the United States and Western European countries; it should also be noted that the proportion shown for the group "other countries" is increasing, which is partly due to the expansion of pig-iron production in developing countries. The figures in brackets, representing the share each of the countries shown holds in world iron ore production, show also the deficits or surpluses in metal availabilities. Most of the principal iron and steel-making countries, except the USSR and France, are iron ore deficit countries, and the relative importance of these deficits has been

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growing considerably during the last 30 years.

21. Ore consumption within the iron and steel industry is in three main sections: in iron ore preparation, in blast-furnaces and in steel-making. Each of these uses has during the last 30 years or so shown its own trends and, hence, contributed to the changing pattern of iron ore output and consumption. The term "ore preparation" comprises also the grading, beneficiation and concentration of ores, but for the purposes of the present study it is sufficient to deal with iron ore used in agglomeration processes, i.e. mainly in sintering and pelletizing. It is in this field that an essential change has taken place during the last 30 years, since well-sized products could be prepared from otherwise useless fines, both natural fines and those arising in transport.

22. The techniques and economic aspects of iron ore preparation are the subject of a substantial literature, disseminated in technical reviews, and largely based on experience acquired in the highly industrialized countries. In view of the significance and range of the various problems involved, a general review of iron ore preparation techniques, and especially of their economic aspects, was undertaken recently under the auspices of the Steel Committee of the Economic Commission for Europe. The study, published in 1966 under the title "Economic Aspects of Iron Ore Preparation"[2/], is part of the background documentation for the International Symposium on Industrial Development. Apart from its treatment of the reasons for iron ore preparation, the methods of preparation, the economic efficiency of the various methods and the present trends in their development, the study contains a survey of iron-ore reserves and their characteristics and also of the state and prospects of iron ore preparation in most countries of the world.

23. From this survey it appears that while preparation methods such as crushing, grinding, screening, blending and some forms of concentration are to be found practically in all iron and steel producing countries, the more advanced forms of "agglomeration" have not made a similar advance in the developing countries.

2/ Economist Aspects of Iron Ore Preparation, ECE Geneva, 1966 (ST/ECE/STEEL/14; Sales No. 66.II.E.6).

24. The main reasons for iron ore preparation can be summarized as follows:

(a) to improve the physical and mechanical properties of the ore by crushing or grinding and screening it, and to remove the fines;

(b) to obtain an ore which is uniform in its chemical composition, especially as regards the content of iron and of the main slag-forming components;

(c) to raise the iron content of the ore, i.e. to obtain "concentrates" richer than the natural ores, and to remove impurities;

(d) to utilize by agglomeration the fines resulting from mechanical mining and blast-furnace operations or produced specifically for agglomeration by prior beneficiation methods.

25. A careful preparation of the ore before smelting reduces the coke rate and increases the productivity of the blast-furnace generally. As a result of a well prepared iron ore charge, blast-furnace conditions are more uniform and easier to regulate. The composition of the pig-iron can be kept much closer to the standards set. Unforeseen stoppages can be reduced. Wear on refractories is substantially less. Losses due to blast-furnace dust are reduced. The use of agglomerates has been one of the factors which in recent years allowed a substantial increase in the dimensions of the blast-furnaces.

26. At the present level of development of iron-ore beneficiation, it is possible to improve the quality of crude ores—in terms of iron content, of impurities, of self-fluxing components and in terms of physical properties—to such an extent that the savings gained from the use of beneficiated ore now considerably exceed the costs of ore preparation. It should be further mentioned that reductions in transport costs, especially over long rail hauls, can be obtained by carrying ores in concentrated rather than in their natural form.

27. The wider use of different preparation processes has also had its effect on the development of methods for using natural fines by transforming them, through sintering and pelletizing, into standard sized pieces, which in modern practice form a large part of the blast-furnace charge. Thus, the development of pelletization on an industrial scale in the United States and in the USSR has made it possible to treat lower grade ores in an economic way. An additional reason for the rapid expansion of these techniques is the high

proportion of fine ores found in the large and iron-rich Pre-Cambrian deposits which have recently been brought into production, particularly in Latin America and Africa; the large scale utilization of these resources prompts commercial exploitation of the fines, and hence agglomerating them at the mine or at the consuming plant.

28. Over 290 million tons of sinter were produced in 1964, whereas in 1937 production was about 5 million tons only. The iron ore used in the production of sinter represented about 45 per cent of the ore mined throughout the world in 1964; in 1937 only about 1 per cent of ore was used for this purpose. Sintering plants were at the time concentrated in countries where the shortage of ores encouraged the use of recovered iron-bearing materials like flue dust or of pyrites ash. Now, however, sintering is being developed mainly with a view to the utilization of fine ores, whether pre-heated or not, and the addition of carefully proportioned products to the sinter bed make it a means of providing a well-sized ore which permits optimum utilization of the blast-furnace. Sintering plants now exist in all countries producing iron and steel, mainly close to the blast-furnace plants as long-distance transport of sinter for some time presented a problem (arising from fines).

29. The technique of producing pellets, the other iron ore agglomerate, is more complicated, and its use has been developed only in recent years, on the basis of the progress made in the theory of blast-furnace operation with sinters. Production was practically nil in 1937, whereas in 1964 world output amounted to 35 million tons, and 1965 capacity is estimated to have been already at 67 million tons; output in 1954 had been less than one million tons. The tonnage of iron ores used in pelletizing plants in 1964 may be estimated to have been at about 50 million tons or 8.6 per cent of iron ore mined in that year.

30. Although the pelletizing process was first used on prepared ores too fine for sintering, the present tendency is also to pelletize ores or concentrates after crushing them to the required degree of fineness, despite the additional cost involved. Thus, not only does pelletizing provide for using a high proportion of fines which were formerly difficult to charge into the blast-furnace, but their advantage has also led to the lump ores, the traditional

blast-furnace charge, being reduced to fines. The metallurgical advantages of pellets have, furthermore, provided the economic possibility to use lower grade ores after concentration from which they arise as fines.

31. It is estimated that in 1964, pelletizing and sintering provided over half the iron required by the iron and steel industry. Moreover, considering the new sintering and pelletizing plants planned or under construction, it may be concluded that the contribution by these processes to covering iron requirements will continue to increase.

32. The increased use of sinter and pellets has already gradually reduced the proportion of unprepared ore in blast-furnace charges and it is to be expected that this trend will persist, at least in countries where very high yields in blast-furnaces cannot be obtained with carefully graded rich natural ores. In 1964, about one-third of world iron ore output was used in blast-furnaces in a non-agglomerated form, whereas, in 1937, almost the entire charge of blast-furnaces consisted of lump ores and concentrates. The extent of substitution of agglomerates for other iron ores and the speed of development in this field was, however, not uniform. In Western Europe the large scale use of sinter is only of recent origin; in 1964, the amount of unsintered ore charged in ECSC countries was about the same as the amount of sinter, whereas in 1950 unagglomerated ore represented still 85 per cent of the burden. For the region as a whole the trend towards increased use of agglomerated ores is so strong that, despite increases in pig-iron production the volume of unsintered ore fell by one-third between 1960 and 1964. The same trend can be observed in Eastern Europe, particularly in the USSR where use of unsintered ore represented in 1964 not more than 13 per cent of the total iron ore charge. In the United States and Canada, the proportion of sinter and pellets in the charge is very near the level achieved in the USSR, whereas in Japan the situation is similar to that in Western Europe.

33. Although the general trend is to use less and less non-agglomerated iron ore in blast-furnaces, it should not be concluded that in the near future good quality lump ore will be systematically crushed and reconstituted into sinter and pellets.

34. While in pig-iron production iron ore, agglomerated or not, is the essential component, in steel making its role is limited to that of an oxydising agent, mainly in open-hearth furnaces, but also in electric furnaces and in some of the new oxygen converter processes. World consumption in recent years has amounted to about 15 million tons, containing some 10 million tons of iron. Although these quantities are fairly small, they constitute a special market for lump ore of high iron content, since the use of pellets and sinter has so far been relatively small in steel making. On the whole, consumption of ore for this purpose keeps pace with the growth of steel production, though it varies in relative importance from country to country, depending on the process pattern of crude steel output. It seems that the over-all demand for steel-making ores should be relatively stable during the next few years.

International trade in iron ore

35. Iron and steel-making is the classical example of an industry which originated on or near the deposits of its principal raw materials, i.e. iron ore and coal, since both are materials of whose crude weight only a certain proportion is retained in the final product. International trade in iron ore is, therefore, a phenomenon which developed on a sizeable scale only after local resources were either depleted or when the local ore because of its low grade and other metallurgical characteristics could no longer economically be used in blast-furnaces. With the improvement of sea and also of land transport facilities, with the discovery of high-grade ore deposits in countries which had no tradition of iron and steel production, and also with the strengthening of the market component as a locational factor for the iron and steel industry, world trade in iron ore has been growing at a fast pace.

36. Whereas at the beginning of this century the total export volume was about 11 million tons (actual weight), this had more than trebled by 1913, and in 1929 iron ore exports were over 45 million tons. The figures given below illustrate the development of iron ore output and trade since 1913 (in millions of tons actual tonnage); data comprise intra-ECSC trade, corrected for deliveries from France to the Saar):

World output of and trade in iron ore

Year	Output	Trade	Trade as percentage of output
1913	177.1	36.7	20.7
1929	202.2	46.6	23.0
1937	216.3	51.5	23.8
1950	243.6	44.8	18.4
1957	427.9	125.9	29.4
1960	513.6	154.7	30.1
1964	573.2	198.4	34.6

37. The data evidence the increasing importance of international trade in iron ore. In 1913 only 20 per cent of world iron ore output entered into international trade and by 1937 this share amounted to 24 per cent. The massive increase in trade during the 1950's resulted in a proportion of trade in output of 30 per cent in 1960 and of close on 35 per cent in 1964. Basing these proportions on data of Fe-content, the share of trade in output is even higher: in 1964, 37 per cent of iron ore production crossed borders before consumption. This higher figure is caused by the fact that the Fe-content of ores entering into international trade has increased faster than that of production in general. In other words, in order to keep transport cost per recoverable Fe-units as low as possible, leaner types of ores are consumed within close distance of the originating mines, whereas higher grades are shipped over long distances. The increase in the Fe-content of iron ores in world trade is illustrated by the following data (Fe-content in percentages):

Fe-content of world iron ore output and trade

Year	Output	Trade
1950	48	51
1957	48	53
1960	49	53
1964	53	56

38. The typical "ore-deficit" regions are easily recognisable, and are concentrated in five geographical areas: the United Kingdom, the ECSC countries, Eastern Europe (excluding the USSR), the United States and Japan.

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Together they accounted in 1964 for almost 95 per cent of world trade in iron ore (imports, actual weight; excluding intra-ECSC trade). The changes in the geographic pattern of ore imports into the principal importing regions and countries since 1950 can be summarized as follows: The United Kingdom obtained in 1950 about 59 per cent of its imported ores from Western European sources (mainly Sweden); in 1964 this share had fallen to 39.2 per cent and Canada and Latin American countries provided together over 31 per cent of the imports. The ECSC countries, were, in 1950, relying almost exclusively on Western European ores (86 per cent of imports); in 1964 only 39 per cent stemmed from this region, Africa, North and Latin America providing the bulk of the remainder. For the United States, the importance of Canada as an iron ore supplier has substantially increased (from 19.7 per cent in 1950 to 58.5 per cent in 1964), most of the rest coming from Latin America; imports of European ores, which were of importance in 1950 (26.3 per cent of all imports) have virtually ceased. Japan, which in 1950 still relied entirely on ore from within the Far Eastern region, has now diversified its sources. In 1964, 52 per cent came from the Far East (mainly India and Malaysia), 31 per cent from Latin America (mainly Chile and Peru) and about 12 per cent from North America. The role of Australia as a supplier of ore to Japan will be much more significant in the ten years to come than it was hitherto.

39. The principal international suppliers of iron ore were, in 1950 and 1964, the following countries (millions of tons, actual weight, and percentages; exports from France to other countries of ECSC have been excluded): (See table 4 annexed).

40. The increasing importance of iron ore resources at greater distance from the principal consuming centres is clearly brought out by the above data. The share of the developing countries in world exports has increased from over 30 per cent in 1950 to 46 per cent in 1964. The increasing significance as suppliers of the sometimes remote centres of consumption is also illustrated by data on ton-kilometres of iron ore carried in sea-borne trade. Whereas this figure was at 103.2 thousand million ton-kilometers in 1950, it had almost quadrupled by 1957, reaching 571.4 thousand million in 1960, and

854 thousand million ton-kilometres in 1964. The tonnage of ore carried during the period 1950-1964 had increased by an annual rate of 9.2 per cent whereas ton-kilometres had grown by 11.2 per cent annually.

41. To complete this section on international trade in iron ore, mention should be made of intra-ECSC trade, which was excluded from the above considerations. Trade within this group of countries has always almost exclusively consisted of exports of French ore (mainly from the Lorraine basin) to the other member countries, the main destinations being Belgium, Luxembourg and Western Germany, particularly the Saar region. However, under the impact of richer ores imported at attractive prices, deliveries of French ores to other ECSC countries have somewhat decreased since 1960, from 26.3 million tons (actual tonnage) to 21.6 million tons. Related to total world trade in iron ore (including intra-ECSC trade) intra-ECSC trade amounted in 1950 and 1960 to about 10 per cent of the total, falling in 1964 to slightly more than 6 per cent.

Price developments

42. No international quotations similar to those that exist for certain base metals (copper, zinc, lead, etc.) are published for iron ore; moreover, a good deal of international iron ore trade stems from "captive" mines and may be carried out at undisclosed prices. For most ore transactions, however, the price is established in contracts between buyers and sellers, taking into account the quantity and time range of deliveries, the iron content, the size range, the impurities (silica, phosphorous, sulphur, etc.) and other physical and chemical characteristics which influence the operation of the blast-furnace. From the point of view of the buyer, the prices will also be influenced by the conditions of supply, regularity of deliveries, stability of ore characteristics as specified in previous contracts etc.

43. According to who provides the sea transport, one or both parties will take ocean freight into account, as well as the conditions prevailing at the shipping and arrival ports, conditions which influence the size of ore carriers to be used and their time of waiting at both ends of the haul.

44. Published data on prices raise certain problems, and they are scarce and often incomplete. Those that are published regularly, such as the Great Lakes quotations in the United States or those for Swedish ores are often only reference figures, which may differ from the "immediate" prices practised. Others, bearing on more clearly defined contracts, mention chemical contents which are not always allowed or do not mention price adjustments which may have been applied.

45. However, the few price data available show at least the trend in the world market. The figures given in table 5 annexed, clearly indicate the downward trend in ore prices after 1957/1958. It will be seen that the fall in prices for Swedish ores between 1958 and 1962-1965 was considerable (12 per cent). Brazilian ores decreased in price by as much as 28 per cent. The general decrease in prices is well shown by the average import price of the United Kingdom which is composed of ore from almost all regions. It fell by 20 per cent since 1958.

46. A similar trend in prices emerges if unit values per ton of ore exported are calculated for the principal supplying countries.

F.o.b. unit values of iron ore exports from selected countries 1953 to 1963
(in $US per ton of iron contained)

Country	1957	1960	1961	1962	1963
Sweden	19.8	17.1	16.8	16.0	14.4
Canada	14.4	17.4	17.0	16.2	17.2
Brazil	20.0	15.4	14.4	13.2	12.8
Venezuela	12.3	14.2	14.2	14.2	12.2
Liberia	16.5	18.0	16.2	13.5	12.0
India	18.7	18.7	18.4	18.7	18.0

It will be seen that there are noticeable decreases in export prices, at least after 1960. The reasons for this almost general deterioration in iron ore price levels are mainly related to the considerable increase in rich ore mining capacity and the slackening of demand for ores caused through developments in the iron and steel market.

Trends and prospects

47. It would appear impossible to provide, within the framework of the present paper, a detailed assessment of future trends in both demand and supply.

However, a number of indications can be given as to expected growth and as to the quality requirements, merely based on already visible features of development or known plans.

48. As far as trends in demand for iron ore are concerned, a number of countries have already announced figures for production of crude steel or pig-iron in 1970; for others, given the short span of time remaining between now and that year, it would appear possible to make rather safe assumptions on the level of pig-iron output to be expected and hence of iron ore requirements which may be reached. For the world as a whole, iron ore requirements (in terms of Fe-content) can, on this basis, be assumed to grow by about 5 per cent annually until 1970. An analysis of iron ore mining plans in the principal ore consuming countries shows that the deficits in supply must be expected to grow. Tentative calculations showed that ore import requirements (in terms of Fe) may in 1970 be around 50 to 60 per cent higher than they were in 1964; this implies an annual growth of import requirements of between 7 and 8 per cent.

49. An assessment of presently known places for the expansion of mines throughout the world shows that, after deduction of domestic iron ore requirements, an export capacity of about 60 per cent higher than actual exports in 1964 would be available. This would mean that requirements for iron ore imports and export capacity should not be very far apart, and it can be expected that the present surplus capacity which has contributed to the depression of prices will diminish, if capacity for export is not expanded at a rate above the estimated 7 to 8 per cent growth in import requirements.

50. The likely developments for 1975 are even more difficult to predict, since detailed studies on future steel demand and production, scrap availabilities and pig-iron requirements are needed to arrive at reliable forecast for iron ore. The first results of such a detailed study[3/] show that world iron ore consumption (in Fe-content) would grow between 1970 and 1975 by

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3/ The World Market for Iron Ore, study prepared under the auspices of the ECE Steel Committee

a further 2.5 per cent to 3 per cent annually whereas import requirements (also in terms of Fe-content) may be growing by about 2 per cent to 2.5 per cent higher during the same period.

51. As far as the supply side is concerned, present proved world resources appear to be sufficient to meet the requirements of the iron and steel industry, at least globally. The resources comprise deposits which are already being worked (and which will not yet be exhausted in 1975), those likely to be in operation in view of the present state of studies concerning them, and ore-bodies which are already known to have adequate resources and quality and which might be opened up in the near future. As regards the latter, the span of time remaining until 1975 is already very short to equip a deposit in an undeveloped region, which will require also the construction of a port and a railway.

52. Taking all these factors into account it would appear that the export potential for iron ore could grow by a maximum of 3 per cent between 1970 and 1975. At this rate of growth, the resulting export capacity would only be slightly higher than import requirements (by about 10 per cent).

53. As far as future developments in the quality of iron ore are concerned, it would seem probablo that the trend towards shipping richer ores over long distances will continue. Pellets are likely to gain in importance for international trade, but also for domestic use of ore fines. Good lump ore will, however, remain important in domestic consumption and also in trade, mainly over medium distances. Sintering can be expected to continue to be widely used for ores which do not have a sufficiently even particle size for pelletizing, and also because of the investments already made. In summary, the breakdown of iron ore output by physical forms in 1970 and 1975 may be as follows (percentages):

Type	1964	1970	1975
Lump ore	47	49	43
Pellets	9	15	24
Sinter	44	36	33

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Table 1

Iron ore production by regions
(in thousands of tons, actual tonnage)

Region	1937	1950	1957	1960	1966
Western Europe	89406	75602	133284	143201	135471
Eastern Europe	30240	43216	89490	114863	156482
Total Europe	119646	118818	222774	258064	291953
North America	76429	102213	128057	108590	117754
South America	2379	5597	28919	42468	48183
Total America	78808	107810	156976	151058	165937
Africa	5982	7035	12840	15473	31780
Asia	11280	8334	30117	83969	86712
Oceania	1897	2472	4093	4677	6077
World Total	217613	244469	426800	513241	582459

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Table 2

Fe-content of ore production
(in thousands of tons)

Region	1937	1950	1957	1960	1964
Western Europe	33 015	28 311	47 415	51 336	51 104
Eastern Europe	16 381	23 181	46 657	60 225	84 630
Total Europe	49 396	51 492	94 072	111 561	135 734
North America	37 877	51 105	65 677	58 046	66 200
South America	1 383	3 528	17 532	25 661	29 520
Total America	39 260	54 633	83 209	83 707	95 720
Africa	3 331	3 937	7 347	9 037	18 882
Asia	5 238	4 038	3 131	32 990	35 810
Oceania	1 158	1 482	2 476	2 890	3 769
World Total	98 383	115 582	200 236	240 185	289 915

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Table 3

Output of iron ore (Fe-content) (by countries)

Country	1937		1964	
	1000 t	%	1000 t	%
France	11 520	11.7	18 439	6.4
Sweden	9 136	9.3	16 349	5.6
United Kingdom	4 299	4.4	4 491	1.5
USSR	15 350	15.6	81 400	28.1
Canada	886	0.9	20 944	7.2
United States	36 991	37.6	45 256	15.6
Brasil	160	0.1	8 438	2.9
Chile	916	0.9	6 109	2.1
Peru	-	-	4 047	1.4
Venezuela	-	-	9 336	3.2
Liberia	-	-	7 668	2.6
Mauritania	-	-	2 898	1.0
Sierra Leone	386	0.4	1 207	0.4
China (mainland)	1 600	1.6	15 000 (est)	5.2
India	1 870	1.9	12 324	4.3
Malaysia	967	1.0	3 941	1.4
Australia	1 157	1.2	3 607	1.3
Other countries	13 165	13.4	28 451	9.8
WORLD TOTAL	98 383	100.0	289 915	100.0

Taking all developing countries together[a/], their output of iron ore (in Fe-content) amounted to 26.7 per cent of the world total in 1964, as compared to 19.8 per cent in 1937.

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a/ Only extra-European countries

Table 5

Prices of iron ores entering into international trade,
1950 to 1965
(US$ per ton)

Year	Brazil	Japan	Sweden	United Kingdom	Venezuela
1950	..	..	8.53	..	..
1954	..	..	11.49	13.83	..
1958	14.37	..	13.19	15.66	7.26
1959	12.23	..	11.48	14.56	7.26
1960	11.42	12.42	11.48	13.50	8.52
1961	11.02	12.89	11.48	13.59	8.95
1962	11.02	12.89	10.80	13.37	8.95
1963	11.02	12.24	10.13	12.55	8.11
1964	10.24	11.86	10.13	12.33	7.79
1965	10.24	11.63	10.13	12.58	7.76

Source: Preise, Lohne, Wirtschaftsrechnungen, Reihe 9, Preise im Ausland, I Grosshandelspreise, Grundstoffe, Teil 3, published by Statistisches Bundesamt, Wiesbaden, issues for Autumn 1962 and Spring 1965.

Note: Brazil: 68 - 69 per cent Fe, f.o.b. Brazilian ports, lump ore;
Japan: Import price, c.i.f. Japanese ports; Goa ore, 58 per cent Fe;
Sweden: Kiruna D. 60 per cent Fe, c.i.f. Rotterdam;
United Kingdom: Average import prices, c.i.f. United Kingdom ports;
Venezuela: Orinoco I; 58 per cent Fe, f.o.b. Puerto Ordaz.

Table 4

The principal international suppliers of iron ore

Country	1950		1964	
	1000 t	%	1000 t	%
Sweden	12.9	38.6	24.2	13.7
USSR	3.0	9.0	22.8	12.9
Algeria	2.4	7.2	2.6	1.5
Morocco	1.0	3.0	1.0	0.6
Sierra Leone	1.1	3.3	2.1	1.2
Liberia	-	-	11.9	6.7
Mauritania	-	-	4.8	2.7
Canada	2.0	6.0	31.4	17.8
United States	2.7	8.1	6.9	3.9
Venezuela	-	-	14.6	8.3
Brazil	0.7	2.1	9.3	5.3
Chile	2.6	7.8	9.1	5.2
Peru	-	-	6.3	3.6
India (incl. Goa)	0.1	0.3	10.1	5.7
Philippines	0.6	1.8	1.5	0.8
Malaysia	0.5	1.5	6.6	3.7
North Korea	0.1	0.3	1.0	0.6
Oceania	-	-	0.4	0.2
Other countries	3.7	11.0	9.8	5.6
WORLD TOTAL	33.4	100.0	176.4	100.0

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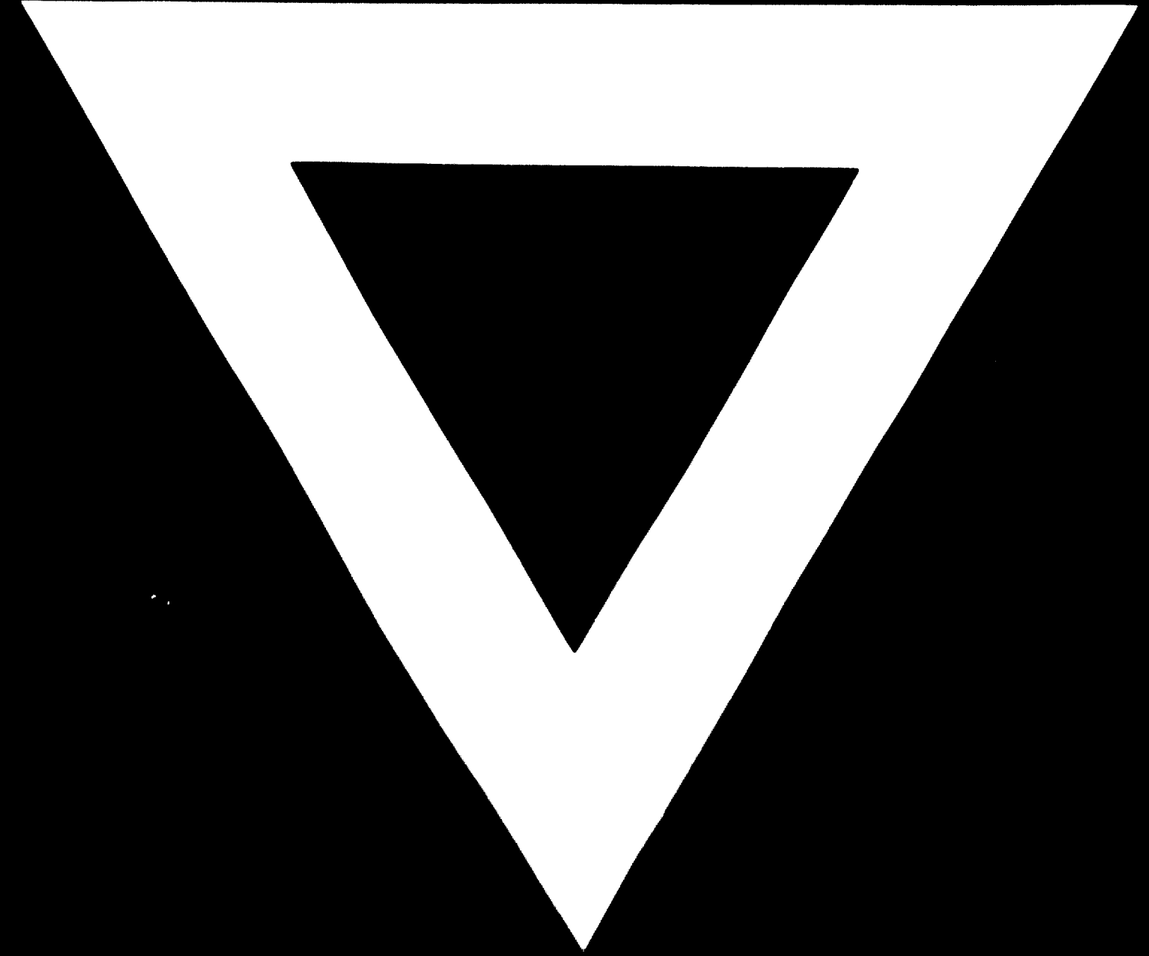

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