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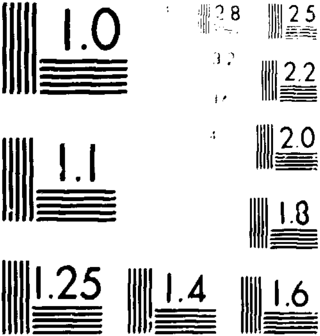

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UNITED NATIONS INDUSTRIAL
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SOUTH-SOUTH COOPERATION IN MINERAL RESOURCE-BASED INDUSTRIES+

by

B. Balkay++

Prepared for the
Global and Conceptual Studies Branch
Division of Industrial Studies

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Foreword

This paper was written as one of the backup essays to the Global Report now being prepared at UNIDO.

It hardly needs pointing out that these times are perhaps more frustrating to the forecaster than any, at least since World War II: one cannot help feeling that the world economy is approaching a cusp from which it will emerge with many trends broken and many sacred cows slaughtered.

At the more practical level, this paper was written when the computer models of the four scenarios envisaged for the Global report had not yet taken definitive shape: it therefore makes no attempt at tying in with those, but merely strives for a verbal formulation of ideas compatible with them, leaving it to the model builders to perform the final, quantified tie-in. It is primarily for that reason that this paper lays such an emphasis on statistics, especially statistics grasping the present.

The writer hesitated whether to place the said statistics in the appendix but, finally, obeying his own reading preferences, decided to place them in the text where they are easier to consult as the argument proceeds.

With a view to self-consistency, all the figures concerning the reserve base /except those for fuels, which are not shown in that source/ were taken from Mineral Facts and Problems, US Bureau of Mines Bulletin 671, the 1980 edition. The figures stated there in non-metric units /short tons, pounds etc./ were converted to metric units. As a result, some of the data are presented to an unlikely degree of accuracy, but this was considered preferable to a great deal of arbitrary rounding. Also, the data were regrouped to fit the UNITAD eleven-region subdivision of the globe. In dividing up some of the more insignificant items, shown under "others" in the source, between the UNITAD regions, subjective judgement was used.

It was one of the writer's prime objectives not to duplicate good work available elsewhere. The reader is therefore referred especially to

- UNIDO's Mineral Processing in Developing Countries, ID/253, which concentrates on the issue of boosting value added in minerals processing and metallurgy,
- 1990 Scenarios for the Iron and Steel Industry, UNIDO//IS.213, which, in addition to being a treasure house of technical detail, lists many development intentions in Southern countries,
- UNIDO's Fertilizer Manual, No. 13. Development and Transfer of Technology Series, ID/250, and
- the Second World-Wide Study on the Petrochemical Industry: Process of Restructuring, ID/WG.336/3.

For petroleum refining, no better source than the periodical Petroleum Economist is needed.

Budapest, 30 November 1982

Executive summary

A.1 Of the mineral resource-based industries, this paper considers petroleum refining, petrochemicals, mineral fertilisers and metallurgy.

2 The South is in a process of economic differentiation. In the industries considered here, the NICs are slated to play a predominant role, as producers, consumers, makers of capital goods and diffusors of technology. OPEC may be instrumental in financing facilities in these industries. For these reasons, much of South-South cooperation may get short-circuited between these two groups. A firm political purpose is required to keep that tendency within reasonable bounds.

3 The delinking scenario as formulated within the UNITAD model is considered by this author as a reductio ad absurdum, useful though unlikely. A gradual, constructive delinking that will boost South-South cooperation without damaging the Northern economies should be aimed at. This should be the essence of the South-South cooperation scenario.

4 The enhanced NN-SS cooperation scenario is tantamount to world-wide Keynesian economic stimulation, largely by the North. Likely to offer better growth prospects all around, it might tend to keep N-S relations in the old rut. Again, a firm political purpose is required to forestall this.

5 The general attitude elaborated in this paper is that the South should aim at an intelligent, gradual collective import substitution.

6 It is imperative to pay more attention to the specific features and attitudes of the EE group of countries.

B.1 Except for a few freak minerals, both the North and the South are sufficiently provided with mineral resources to get by without the other half of the world, but the deep restructuring of mineral production and trade patterns that such a severance would necessitate would be so much wasted effort. A just and equitable world mineral economic climate with adequate safeguards to both producers and consumers on UNCTAD Common Fund or International Tin Agreement lines would be preferable.

C.1 Petroleum refining is widespread in the South, where 73 countries have refineries.

2 The distribution of petroleum reserves and production is so biased that most Southern countries are as dependent on the oil-exporting countries as some of the North is.

3 Developing countries that possess either ample reserves of crude or a sizeable domestic market may profitably expand their refining sector. This would entail an input starvation phenomenon squeezing out increasing volumes of refining capacity in the North.

4 Refinery technology is still very much of a Northern monopoly.

5 Developing-country importers receive the quasi-totality of the crude and more than half the products imported by them from developing-country exporters. The product percentage could be increased to 80-85 %.

6 Current instances of South-South cooperation are confined to financing and marketing, exploration, training, and rare instances of technical assistance.

D.1 Basic petrochemicals considered are ethylene, propylene, butadiene, benzene, the xylenes and methanol.

2 Natural gas and refinery products are considered as feedstocks. Flared natural gas is an obvious petrochemicals source.

3 Basic petrochemicals making is not widespread in the South: in 1979, only 13 countries manufactured ethylene and only seven each made butadiene and benzene. By 1990, the numbers are expected to attain 30 for ethylene and 10 to 12 for butadiene at the two extremes.

4 Southern capacities for making basic petrochemicals are

somewhat short of consumption levels, yet Southern countries do export basic petrochemicals to the North. Short-circuiting these trade flows within the South should be envisaged.

5 South-South cooperation in basic petrochemicals is virtually non-existent and does not seem to enjoy priority as such anywhere. It would be useful to make an effort at changing this attitude.

E.1 Mineral fertilisers - the resource base. Phosphate rock is very much a Southern, potash a Northern mineral. The latter is perhaps the most important deficit mineral of the South. Nitrogen fertiliser potential is a function of the availability of some fossil fuel, preferably natural gas or some refinery product.

2 Fifteen Southern countries export phosphate rock, 39 produce and 19 export phosphate fertiliser, 47 produce and 28 export nitrogen fertiliser, but only four produce and two export potash fertiliser, for want of suitable mineral deposits.

3 By 1990, the South is expected to be self-sufficient in nitrogen fertiliser but to still have a phosphate fertiliser deficit, despite the excellent reserve situation. Building facilities to satisfy this uncovered demand is a viable opportunity. In potash, the Southern deficit will persist, but it is probably not worth the effort - except under delinking - to go for self-sufficiency.

4 South-South cooperation in regional fertiliser capacity allocation, joint ventures, training and marketing etc. has a very good record which carries the seeds of its own flourishing. It should be studied by other industries.

F.1 Metallurgy: iron and steel, aluminium, copper, lead and zinc and tin are considered.

2 In ferrous metallurgy, iron ore is abundant in almost every world region, but coking coal distribution is biased in favour of the North. Many developing countries have developed or developable hydropower resources: electric steelmaking should be their option.

3 The conventional iron and steel complex is too big for many

developing economies. The smaller ones prefer unconventional facilities /direct-reduction, electric or charcoal-based/ combined with midi or mini rolling mills.

3 By 1985, 10 developing-country steel producers, all of them in NICs /including India/ are expected to join the group of the world's 50 biggest.

4 Awareness in the South of the potential of cooperating in iron and steel seems today to be confined largely to tentatives to improve the terms of sale of iron ore.

5 In <u>non-ferrous metallurgy</u>, bauxite, copper ore and tin ore reserve distribution are biased in favour of the South; lead and zinc ore distribution, in favour of the North.

6 In 1979, Southern production was greater than Southern consumption in copper, lead and tin, but less in aluminium and zinc. with the OA group disregarded, the South had a surplus in aluminium too.

7 Even in metals in which the South has a surplus, trade flows tend to pass at least partially through the North. Some of these flows could be short-circuited, South to South.

8 The role of the International Bauxite Association and the Conseil des Pays Exportateurs du Cuivre in boosting metallurgy in the South can be important and should be studied. The experience of the International Tin Agreement is also of relevance.

9 There are numerous metallurgical plantmakers in the NIC countries of the South.

G.1 A system of Global Trade Preferences among Developing Countries /GSTP/ could be instrumental in boosting the setting up of facilities for the higher processing of minerals-based commodities in the South.

2 The way in which the benefits, including tariff reductions and higher processing, of enhanced South-South cooperation and economic progress, should be split is by no means clear as yet.

3 A case study of Brazilian trade with Africa reveals that intra-South trade may duplicate many of the features of North-South trade.

4 It also points to the ways in which poorer or less developed Southern countries may boost trade with the richer and more developed ones /the quid pro quo issue/.

5 Intra-South movements of manpower so far have been scanty. They have, however, revealed the possibility of intra-South brain drain.

6 Intra-South training may with the least effort become the most important facet of South-South cooperation in industry.

7 As to future institutional framework of South-South cooperation in mineral resource-based industries, the example of the international ore mineral associations and of the regional fertiliser associations may be taken as a basis.

8 There is considerable availability of technology within the South for the industries considered here, but there is an inadequate systems consultancy cap city; also, the most sophisticated components of the systems have to be imported for the time being.

9 In a delinking situation, the South would be able to muddle through in technology on its own, but it probably would not be able to satisfy with its present capacities all the technology needs of the South from the beginning.

10 As to the impact on the North, an enhanced South-South cooperation would probably do little immediate harm per se and bring some long-term benefits. It would, however, cause some damage to the North in a period of deep recession.

11 Delinking would cause great harm. Trade patterns of minerals and minerals-based commodities would have to be restructured extensively and unfavourably. NN-SS enhanced cooperation would have to be financed jointly by the North and the capital-surplus

South. The problems would be to create the right atmosphere therefor and to distribute the benefits evenly.

12 UNIDO would have to perform some more profound studies into certain aspects of these subjects; to help disperse the momentum and experience of Southern initiatives in fertiliser and ore mineral cooperation to the other industries mentioned here; to sponsor and supervise the training of Southern nationals in the South; and to provide or sponsor systems consultancy in the said industrues.

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A Introduction

It is becoming increasingly unjustified to consider the South or Third World as a unity for any purpose whatever. Work on "UNIDO Global Report" avoids this pitfall by subdividing the South into six regional groups, one of them centrally planned. As far as South-South cooperation is concerned, however, it is useful to consider another subdivision, not separately from, but in combination with, that regional grouping, one in which the respective sizes and levels of sophistication of the developing countries are given the prime role. In such a grouping, we have the NICs in a broad acception of the term /so as to include India, for example/ at one end of the range and some poor land-locked quasi-subsistence economies at the the other. Countries at opposite ends of the range can and do occur within one and the same regional group; in fact, they may be next-door neighbours; Nigeria and Niger are the obvious example.

It is submitted here that the NICs so defined will have an overwhelming role to play in any scenario of South-South cooperation over the next twenty years /by the end of which some of them may not even qualify as developing countries any more/. They will increasingly evolve interest patterns, attitudes and forms of economic behaviour converging to those of the developed economies of today whose social systems they adopt. Their attitudes will not be uniform: on an average, however, one may predict them to be more laissez-faire and less paternalistic than today's developing-country attitudes at large. Absence of guilt over a colonial past may be a strong element thereof. Within the South, the NICs would, insignificant exceptions apart, be the only serious source of capital goods and technology for the industries to be envisaged in this paper; they would also, in any de-linking situation, be together with OPEC called upon to finance a major part of growth in the South.

The NICs would also, with some qualifications, be the most important Southern markets for Southern products. The qualifications have to do with the degree of complementarity or otherwise of the different Southern economies. Distorted growth patterns under the basic core-periphery relationship between the North and the South so far have acted towards uniformising the South and reducing the complementarities inherent in natural endowments which, in many respects, had been too similar anyway to start with. There are many shades of complementarity or of the lack of it within the South; most of them will probably become enhanced as the South recovers its economic identity. At the ends of the range, Brazil is a mineral giant in all except fuels, but a hypothetical grouping of, say, Brazil, Colombia and Mexico would be just about self-sufficient over the whole gamut of minerals and, hence, potentially at least, also of the mineral resource-based industries. In contrast, the NICs of Southeast Asia have an almost Japanese sensitivity to mineral imports and much the same attitudes to those. The crucial issue is, of course, what goods produced in the South can the NICs and capital-surplus OPEC be expected to absorb in payment for their supplies of capital and capital goods? The Southeast Asian ones will be eager to absorb minerals, and also, if they cannot avoid it, minerals-based commodities of higher processing. Our hypothetical grouping of South American countries, on the other hand, would be so self-suficient - and also, with its hosts of cheap labour, so interested in protecting practically a[illegible] domestic industries - that offsetting trade flows <u>into</u> [illegible]ion would be a considerable problem, a clear case of ins[illegible]ent complementarity. /Brazil taken in itself is not by far so self-sufficient, as we shall see it later./

Another hazard is that much of South-South trade may get short-circuited just between the NICs and OPEC, leaving the NOPEC /non-NIC and non-OPEC/ countries out in the cold.

A.1 <u>Complementarity and a classification of South-South relations</u>

The above line of thought provides a frame of reference to degrees of complementarity within the South and a useful criterion for subdividing the cooperation relationships that may arise. Disregarding autarky by any country as meaningless for an enquiry into South-South cooperation, we find <u>subregional cooperation</u> as the smallest possible cell, and find that, for reasons of geographic vicinity, similarity of climate etc., the <u>prima facie</u> likelihood of complementarity is least /to stick with our example above, the question as to what Niger can offer Nigeria in cooperation requires some very careful thinking out/. Cooperation in the mineral resource-based industries may nevertheless make good sense if it permits to profit by the <u>economies of scale</u> inherent in the technologies involved. /An example that comes to mind is fertiliser cooperation within ASEAN, to be detailed below./

At the subregional level, complementarity as to natural resources is likely to be partial: in neighbouring countries, natural resources endowments have a fair likelihood of being similar. For example, Mozambique has a good grade coal and Angola a good grade iron ore, but both are rich in electric power. But Mozambique also has iron ore, albeit of a poorish grade. This being the case, what makes more sense: to put up a joint-venture ferrous metallurgy operation and incur the additional sea freight cost between, say, Maputo and Luanda or the other way round, or to save the freight cost and set up two separate operations with just a minerals swap? Clearly, answering such questions requires a fairly thorough feasibility study: they cannot therefore be tackled here except in the most general terms.

<u>Regional</u> as distinct from subregional <u>cooperation</u> raises much the same questions except that complementarity is somewhat

more likely. Also, regional cooperation will make sense for operations the least economically viable size of which is too big for subregional markets to accommodate. This latter issue is, however, a function of the state of the art in technology at any given time: 15 years ago, a steel complex in the South would typically have been viable at the regional level only /except in region-sized countries like Brazil or India/, whereas the advent of the mini and midi steel plant today permits countries with small economies to integrate at the subregional level and larger countries to go it alone. In contrast, an aluminium industry will, if not export-orientated, will probably be viable, if at all, regionally /rather than subregionally/ only.

The prime point about interregional cooperation, in addition to the fact that it offers the greatest complementarity, is that it involves all the technical paraphernalia of South-North /or North-South/ trade, specifically including marine shipping and portuary facilities. The globalisation of trade in minerals and the products of some mineral resource-based industries after World War II was made possible in the first place by technological progress and gigantisation in marine haulage. Minerals and the products of mineral resource-based industries being bulky as a rule, the costs of loading, haulage and unloading tend to loom large in any transaction of interregional trade in these goods. This is even more so with the products of higher processing /higher value added/: iron ore e.g. is cheaper to haul, per unit of contained iron, in specially constructed ore carriers or OO /ore-oil/ or OBO /ore-bulk-oil/ vessels than, say, merchant bars of steel. Still, sea freight is so much cheaper as a rule than any sort of land freight that a site close to tidewater is a must for any facility intended for interregional exports. Thus even though political will may be a major factor in setting up arrangements of subregional or regional cooperation, economic considerations will probably gain the upper hand in interregional ones.

A.2 The scenarios

Four scenarios have been envisaged for the UNIDO Global Report:

- a Trend scenario, which is essentially a statistico-logical construct,
- a North-South delinking scenario,
- a South-South cooperation scenario, and
- an enhanced NN-SS cooperation scenario.

As regards the delinking scenario, what with the underlying idea of any South-South cooperation, enhanced or otherwise, being priority to trade and cooperation between/among Southern countries/regions /in contrast to a laisser-faire approach in which North-South links would probably go on growing to the detriment, more or less, of South-South links, actual or potential/, any analysis of South-South cooperation is of necessity overshadowed by the spectre of de-linking. This writer, probably along with everyone else, considers delinking, in the absolute sense stipulated by the delinking scenario envisaged for the Global Report, to be very unlikely indeed, but considers it to be a fair and useful reductio ad absurdum from which to start looking at the other scenarios. He further suggests to introduce at this point the concept of parameterised de-linking which, instead of a yes-or-no choice /1 vs. 0 in computer parlance/, is characterised by a de-linking parameter somewhere between zero and unity. Delinking with diffusion /a trickle of partly-smuggled goods, of capital and, in particular, technology between N and S - on the pattern of, say, links between the Allies and Germany through the neutrals in World War II/ would perhaps have a parameter of 0.95, whereas a gentle drift towards an enhanced South-South cooperation /constructive de-linking to a degree while maintaining all useful relations with the North

+ Cf. e.g. An Outline of UNIDO Global Report 1982 /Draft/, dated 23. Sep. 1982, signed Y. Lim.

and minimising economic damage to the latter/ would probably have a parameter rising from 0.10 in 1985 through 0.2 in 1990 and - hopefully - 0.3 by 2000.

The de-linking parameter is a useful guide in matters of world-wide /world market/ competitiveness. Clearly, in a 0.8 to 0.95 delinking situation, it is largely irrelevant whether or not a good, a process or a service is competitive with the comparable goods, processes and services of the industrially developed world, whereas in 0.1 to 0.2 delinking, competition remains vitally important: in the latter case, any industry producing for export /including into other developing regions/ will have to measure up to some international yardstick of competitiveness. This in turn will give the developed, industrial world a built-in competitive edge, maintaining or indeed enhancing its role as an arbiter of what is competitive and what is not. In such a situation, then, enhancing South-South cooperation will probably not be possible on the economic merits of the idea taken in themselves. An act of political will will be required to promote South-South cooperation nevertheless, in the teeth of some short-term economic drawbacks, and a great deal of fine-tuning and a very keen appreciation of the situation will be needed if economically indifferent /or, in fact, not even remotely viable/ projects, mooted just because they look good politically, are to be avoided.

The scenario of enhanced NN-SS cooperation and world Keynesianism. Much had, up to about 1975, been talked about the merits of the Keynesian ideas of economic stimulation; many are the detractors thereof today. Was Keynes right all the time or wrong all the time? Or is a mixture of the two possible? This paragraph sets out to show that it is. Keynes based his ideas on the tacit assumption of an economy functioning as a closed system /the "national economy" concept that is becoming less and less real in our times/, in which factors of production did not cross frontiers. Today, on the other hand, the only closed system in the world is the world as a whole. If this assumption is any good, then a Keynesian stimulation of the world economy as a whole should be a workable idea. In fact it is. In this writer's view, the history of the world economy since 1973 has been that of the Keynesian stimulation of the Southern economies by the developed market-economy countries, largely financed by inflation in the latter. The present sorry state of the world economy is due to a considerable extent to the fact that, faced with a banking crisis and sick and tired too of runaway inflation in their countries, the developed market-economy countries have stopped that stimulation short. The relevance of this to the present enquiry is twofold. Firstly, if no further stimulation is to be forthcoming, this man-made disaster trap will bring de-linking and all that it entails closer day by day, and it will become more difficult day by day to man-unmake that disaster. Secondly and on the other hand, if stimulation picks up again, which this writer feels to be the key to an enhanced NN-SS cooperation scenario, it will carry a price tag: all the transfers to the developing world will have to be spent on purchases in the North, including massive volumes of capital goods and technology. This would of course hinder to a considerable extent the enhancement of South-South cooperation, except in a few privileged situations /such as refining and petrochemicals in the OPEC countries/, and except in the rather long term /1990 to 2000?/.[+] The inference is that political will would be even more indispensable as a prerequisite of giving South-South cooperation its due under enhanced NN-SS cooperation.

All in all, then, the best way of looking at enhanced South-South cooperation under any scenario except a high-degree delinking would be to view it as a sensible and economically justifiable form and degree of collective import substitution. It could and should then be judged by the standard criteria of import substitution vs. export orientation.

[+] It would in fact tend to re-enhance old-style trade patterns.

A.3 <u>The issue of the EE region</u>

The single major blind spot of the scenarios as formulated above is the failure to distinguish the EE /East European centrally planned, i.e., with the exception of Albania, the CMEA or Comecon/ group of countries within the North. This is a major shortcoming in the delinking scenario where this group could be counted upon to side with the South. Having a capital goods sector that is oversized if anything, this group could, <u>in that situation</u>, become <u>the</u> major supplier of the most sophisticated industrial machinery and equipment available to the South. Having too an extensive R+D potential, it would probably also become <u>the</u> major source of industrial innovation. This holds for mineral resource-based industries probably more than for any other, where the performance so far of this group has been one of the /if not <u>the</u>/ best. As to what the South could offer to the EE group in payment for such enhanced flows of goods and services, one must keep in mind that, within the EE group, Eastern Europe /not including the USSR/ is heavily minerals-deficient, and the European USSR is declining into various shortages, while the development of the vast tracts of minerals-rich land in Siberia is placing an increasing burden upon the economy of the USSR. It would make sense to replace part at least of such an extensive development programme by imports. Crude oil imports would probably be the most important in dollar terms; phosphate rock or phosphate fertiliser and/or bauxite/alumina the most important as a percentage of intra-EE consumption; but iron ore, non-ferrous metals and some steel alloying elements would also come in handy. It is important to realise that this situation is already in the making today: not counting Rumania, the small East European countries import about 8 to 10 % of their crude needs from the developing world, and the EE region is the second biggest rock phosphate importer after WE /cf. Table 15/. Furthermore, the EE region with its systemic shortage of labour would also be willing to take consumer goods from the South /as cf. USSR-Indian trade/, provided it could pay for them in capital goods and technology.

In the South-South, NN-SS and trend scenarios, the failure to treat the EE group separately does not matter that much, but the implications of its existence and of its distinctive stance and features should certainly be explored.

A.4 The issue of capital formation and capital goods production

In a delinking situation, the South would have no major problems supplying itself with minerals: see below. It is further submitted that its capital goods makers, a group practically confined to the NICs, would have no major problem, either, supplying it with equipment for the industries considered in this paper. /The point will be considered in more detail later./ This statement requires some elucidation. It does not mean that the NICs are in a position to supply all the trend-scenario needs of these industries with the most modern, computerised-automated equipment representing the last word in world market competitiveness. The NICs are in a position to supply a goodish grade workable second-rank equipment to mineral resource-based industries and can even do better than that in a number of cases. Delinking would also give a tremendous boost to inventivity and innovativity in the South. As pointed out above, world market competitiveness is likely to become irrelevant under delinking. So is, partly in consequence, most of computerisation and automation. It is under delinking that appropriate technology becomes well and truly appropriate. The NICs' capacity to supply capital goods would be significantly less, too, than aggregate Southern needs in the optimum case, but rates of Southern capital formation, unbolstered by loans from the North, would also be insufficient to sustain trend-scenario rates of expansion in these industries. In fact, it would be the rates of capital formation and the rates of capital goods production in interaction that would probably determine /or at least would be one of the major determinants of/ economic growth in the South.

One key issue is budget policy in the NOPEC countries. Under tremendous pressure to maintain living standards, create infrastructure and fight inflation and terms-of-trade erosion in the world markets, few of the NOPEC countries will be able to maintain adequate rates of capital investment into productive facilities unassisted by outside borrowing, or indeed even when so assisted. Most NICs and NICs-to-be have heavy debts to service and also depend for sustained growth at acceptable rates on external borrowing. Thus even if some on-lending by the NICs to the NOPEC countries may in fact take place, mostly in the form of supplier credits attached to sales of machinery and equipment, the rate of industrial development in the NOPEC group and, together therewith, the rate of expansion of that part of South-South cooperation not short-circuited between the NICs and OPEC is likely to depend on infusions of capital from the North and/or from capital-surplus OPEC. With reference of the concept of world Keynesian stimulation posited above, capital from the North may, in the who-pays-the-piper-calls-the-tune mode, seriously hinder South-South trade in capital goods. It is less likely to so hinder South-South trade in the products of the mineral resource-based industries, but then, not much of those products can be expected to originate in the NOPEC group. This highlights the issue, to be explored below within the terms of reference of this paper, of the quid pro quo, of what the NOPEC group can do to integrate itself more into the patterns of an emerging South-South cooperation.

B The resource base

By and large, all minerals taken together, mineral wealth tends to be proportional to surface area for large enough portions of the terrestrial crust. A great deal about mineral wealth/poverty can be learnt simply by looking at the respective surface areas of the 11 regions defined by UNITAD:+

NA	14.24 %	of world land area		
WE	5.06 %			
EE	17.24 %			
JP	0.27 %			
OD	6.76 %			
LA	15.14 %	Develcped:	43.57 %	
TA	15.14 %			
NE	10.26 %			
IN	3.78 %			
AS	3.25 %			
OA	8.86 %			
		Developing:	56.43 %	

It follows that, again taking all minerals together, both the North and the South can get by mineralwise without the other half of the globe. The South, however, can get by better, not only because it is bigger but also because, for the time being, its annual consumption of each mineral is so much less.

Looking at individual minerals, there are freaks like petroleum concentrating in the Middle East or potash in North America and East Europe, or phosphate rock in the region defined as NE. The details emerge from the tables in the text below. The conclusions as far as the present enquiry is concerned are that

1 any delinking would of necessity entail a major restructuring of mineral production and trade patterns,

+ Specifically, the Japanese quandary emerges with great clarity.

2 an enhanced NM-SS cooperation would entail+ a reversal of the current trend under which mining investment, and geological exploration even more so, is shifting out of the South and into the North, i.e. into costlier but safer resources; reversing those trends would need adequate safeguards concerning the safety and security of mining investment and the profits thereof to the investors, plus some form of income/profit guarantee to the host country, on Lomé Convention or UNCTAD Common Fund lines,

3 South-South cooperation under a business-as-usual scenario /that is, in the absence of either de-linking or an enhanced NM-SS cooperation/ has the greater a potential, the more biased the distribution of a given mineral is. This proposition breaks down into two sub-propositions, concerning the inter-regional and the intra-regional distribution, respectively, of mineral wealth. The details are to be given a closer look below. The main point here is that, if the recent history of, say, South-South oil trade is anything to go by, mineral exporters will not sell their goods cheaper to other developing countries than to the developed ones of the North; so the principal advantage to the buyers would be if they could pay for their purchases in their own manufactures and/or agricultural produce, expanding their outlets therefor. Mutual tax, customs, etc. rebates could be another benefit.

Under any form of delinking, there would be a dearth of minerals and mineral-based commodities in the North and a surplus in the South at least until 1990 but probably beyond, to the point of time when demand in the South will have caught up with existing productive capacities. Conversely, a shortage in the South and a surplus in the North may be expected to develop in most of those

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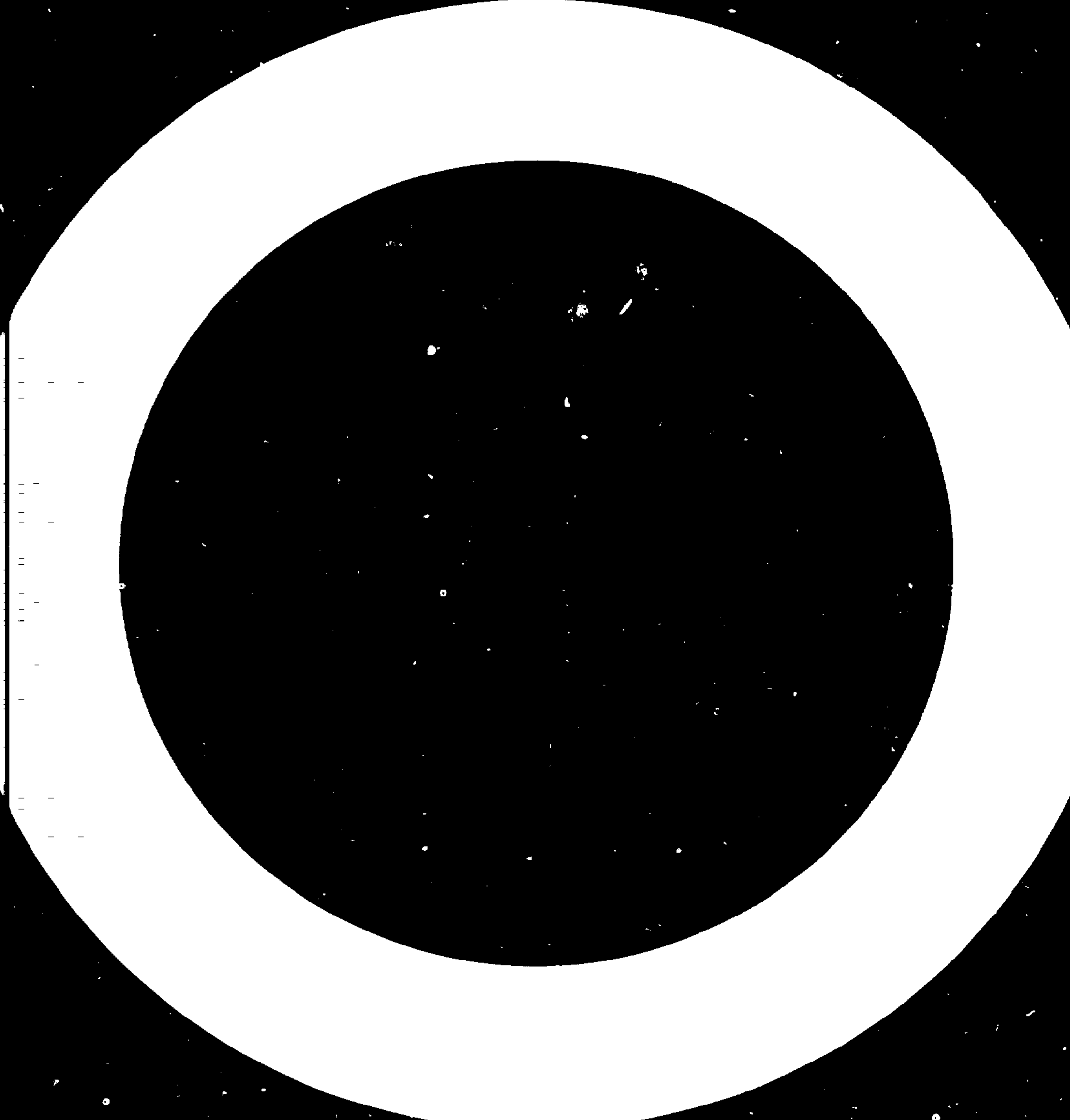
+ or, indeed, presuppose

mineral-based commodities at a higher level of processing of which there is a shortage of capacities in the South. For the details, see below.



C Petroleum refining

C.1 The resource base

World proven crude oil reserves are presented in Table 1. The distribution is very highly biased in favour of just two developing regions, NE and LA. The remaining developing regions are rather worse off than NA or EE, and cover the same range as WE, OD and JP. The events since 1973 have demonstrated that, if the North is dependent on oil from the oil-rich countries, then so is most of the South.

Expensive oil and the cornering of the market by OPEC have actuated compensating mechanisms working towards more oil and more of it outside OPEC. OPEC's share of production declined from 52 % in 1972 to 34 % in first-half 1982; that of the non-OPEC developing countries including China rose from 6 % to 17 %. Since 1970, the ranks of oil producers have been joined by Guatemala, Norway, Greece, Cameroun, the Ivory Coast, Ghana and the Philippines. In 1981, the oil discovery/production ratio exceeded 2.0 for the first time since 1969 /it averaged 1.46 between 1969 and 1976 and 0.91 between 1976 and 1981/.+ Between 1979 and July 1, 1982, crude consumption declined by 15 %. As a result, the psychosis of immediate shortage has receded and a more rational view prevails, by which no non-man-made shortages of crude oil need be feared at least up to the end of the century.

Apart from *bona fide* saving and substitution, this view is corroborated by changes in refinery technology which permit to wring more light and middle distillates out of a barrel of crude and in changes in both production and refinery technology which permit to extract and refine crudes far towards the heavy end of the spectrum with something like acceptable profitability.

Having said this, it is to be emphasised that the problem of distributing world-wide the oil produced in a comparatively few countries is a problem that still looms large. What with both the

+ IEA, *World Energy Outlook*, OECD, Paris, 1982.

major petroleum exporters and the countries hardest hit by the high oil prices being developing ones in the main, this is an arena of South-South cooperation where much remains to be done.

C.2 Refining - the size of the problem+

Each year, refinery throughput practically equals crude oil consumption world-wide and country by country:

million tons: world	1976	1977	1978	1979	1980
Refinery throughput	2796.7	2922.2	2994.7	3076.6	9943.3
Crude consumption	2836.2	2980.4	3039.1	3122.0	2989.0

World refinery capacity, on the other hand, was 3,740,000 t in 1976 and 4,126,000 t in 1980, giving utilisation factors of 0.75 and 0.71, respectively. Utilisation has further declined since, drastically so in places /1981: 0.57 in the FRG and 0.51 in Italy/.

Table 1 presents refinery capacities and throughputs compared with crude production. It shows for 1980 a capacity utilisation of between 100 and 90 % for OA; between 90 and 80 % for IN + + AS and EE; between 80 and 70 % for NA; between 70 and 60 % for WE, JP, OD, LA and NE; and below 50 % for TA. Nevertheless, up to 1986, existing refineries are to be expanded by 108 million tpy, and a further 132 million tpy worth of new capacity is to be added on, 32 % of the total in the Middle East. By contrast, the scrapping of some 160 million tpy is expected in WE alone.++

This picture essentially means that, between crude prices insensitive /or not sufficiently sensitive/ to a declining demand and consumers unwilling to pay even current prices for products,

+For some of the data and arguments in this section I am indebted to my colleague Sándor Sipos and his "A tőkés világ olajfinomító iparának válsága és egy uj munkamegosztás lehetőségei" /Crisis in the capitalist world refining industry and scope for a new division of labour/, a manuscript, World Economy Institute of the Hungarian Academy, 1982.

++Petroleum Economist, September 1982, pp. 375-377, and September 1981, pp. 389-396.

Table 1

World oil production, refining capacity and throughput by regions, 1976 and 1980

Region		Crude production	Refinery throughput	Refinery capacity	Crude production	Refinery throughput	Refinery capacity
		1976	1976	1976	1980	1980	1980
		million tons					
1	NA	465.8	771.5	932.4	494.4	772.1	992.6
2	WE	44.6	677.1	1025.8	122.3	648.5	1061.4
3	EE	539.2	511.7	550.0	619.7	596.5	664.1
4	JP	0.6	209.4	296.8	0.4	204.8	297.0
5	OD	19.5	44.3	60.2	19.2	45.0	66.6
6	LA	225.3	255.1	407.1	289.0	285.5	469.5
7	TA	125.7	15.5	22.9	129.1	21.3	36.4
8	NE	1261.1	135.4	189.7	1090.1	116.9	244.6
9 10	IN AS	103.5	120.0	184.3	116.1	169.6	206.4
11	OA	85.0	71.2	72.0	106.0	83.2	87.1
Totals		2870.3	2812.2	3741.2	2986.3	2973.4	4125.7

Remark. Totals do not agree with the figures on p. 16 owing to rounding.

Source: UN World Energy Statistics, 1979.

refinery margins have actually turned negative: in 1981, refining and marketing losses averaged almost $4.60 per barrel over the six largest Western European markets. Sooner or later, this squeeze is expected to work through to, and depress the prices of, crude petroleum; refining margins will improve, but cutthroat competition will remain. This means that two types of country will find themselves in a comparatively favourable situation: /1/ those which, producing more crude than they can refine, can convert some of their crude exports into product exports, keeping refinery resi-

Table 2

World proven oil reserves, 1979

Region		Proven reserves million tons	Proven reserves %	Region		Proven reserves million tons	Proven reserves %
1	NA	4630	5.47	7	TA	1983	2.32
2	WE	1953	2.28	8	NE	55117	64.43
3	EE	8366	9.78	9	IN	385	0.45
4	JP	3	0.00	10	AS	1908	2.23
5	OD	287	0.34	11	OA	2632	3.08
6	LA	8284	9.68	World		85548	100.00

Source: UN World Energy Statistics 1979.

Table 3

Share entering into world trade of crude petroleum and energy petroleum products, 1980

Product	Consumption million tons	Consumption % of all products	World trade million tons	World trade % of all products	World trade % of consumption
Crude	2 898.0	n.a.+	1 543.9	n.a.+	51.7
LPG	113.7	4.56	24.1	7.22	21.2
Aviati[illegible]gas	3.0	0.12	0.9	0.28	31.2
Motor gas	628.0	25.18	34.8	10.41	5.5
Kerosene	119.5	4.79	7.3	2.20	6.1
Jetfuel	74.3	2.98	16.2	4.84	21.8
Diesel	662.2	26.55	97.5	29.16	14.7
Residual fuels	811.0	32.52	153.5	45.90	18.9
Statistical discrepancy	82.4	3.30	-	-	n.a.+
Total energy products	2 494.1	100.00	334.4	100.00	13.4

+ not applicable

Source: UN World Energy Statistics, 1980

Table 4

Consumption and net imports of energy petroleum products+

Region	Consumption thousand tons	Consumption %	Net imports thousand tons	/Share of crude oil prod., %/
1 NA	747 472	30.27	62 094	16.56
2 WE	577 606	23.39	41 220	4.10
3 EE	437 415	17.71	- 47 933	20.75
4 JP	187 462	7.59	22 965	0.01
5 OD	39 660	1.61	2 900	0.64
6 LA	172 660	6.99	- 80 573	9.67
7 TA	19 293	0.78	3 726	4.32
8 NE	79 221	3.21	- 39 794	36.50
9 IN 10 AS	131 171	5.31	6 890	3.89
11 OA	77 716	3.15	90	3.55
Stat. diff.	-	-	28 415	-
Totals	2 469 676	100.00	0	100.00

Source: UN World Energy Statistics, 1980

dues as an industry fuel; with the huge profits made on the crude, a negative refinery margin is purely an accounting convention with them; and /2/ those who, needing more products than they can currently refine, can build up refinery capacity in the shelter of a domestic market. OPEC countries are likely to fall into the first group; developing countries with a sizeable products market into the second. The developed regions with excess refining capacity will find themselves squeezed in the middle, a classic case of input starvation. This is a process that may come about simply under the influence of the market forces, without any political will or action on the part of those concerned.

+ The only non-energy product that may be of interest here, naphtha, a petrochemicals feedstock, makes up slightly less than 3 % of total energy-products consumption in the world.

Table 5

Major oil-importing developing countries: crude and products imports, million tons

	1979	1985		1990		1995	
	fact	low	high	low	high	low	high
		projected					
Brazil	47.5	44.0	53.5	52.0	78.0	63.0	99.5
Hong Kong	5.0	7.8	8.5	6.3	8.1	7.2	10.5
India	15.3	-0.1	13.6	-0.6	14.6	0	31.0
South Korea	26.3	31.0	38.0	57.0	73.5	93.5	112.0
Philippines	8.7	4.7	7.6	2.4	5.5	0	5.8
Taiwan	19.0	26.2	32.3	35.5	52.5	61.5	81.0
Thailand	10.6	10.0	11.7	7.2	11.0	9.6	14.3
Turkey	13.7	11.3	13.3	10.4	14.0	8.6	15.3
Argentina	2.8	-7.5	-4.2	-13.4	-6.3	-16.7	-4.6
Chile	3.9	3.2	4.4	3.2	4.8	1.1	5.1
Cuba	9.3	10.7	11.4	12.5	13.1	13.8	14.5
Morocco	3.1	3.8	4.2	2.2	3.0	1.3	3.0
Pakistan	3.8	1.4	2.7	0.7	2.8	-0.2	3.2
Total	169.0	146.5	197.0	175.4	274.6	242.7	390.6
Probable total +	n.a.	164.0	179.5	204.0	246.0	289.0	344.5

\+ Since it is unlikely for all these countries to have oil imports at the high or low end of the range in one year, a statistical method has been used to produce a likely low and high total.

Source: Petroleum Economist, September 1982, p. 366.

It should be added, to round out the picture /Tables 3 and 4/, that /1/ whereas more than half of the crude oil produced in the world is distributed through foreign trade channels, only 13 % on average of energy petroleum products is. As another noteworthy feature, there are only three regions in the world that are net exporters of refinery products: the two regions with the greatest share of crude production, NE and EE, and, remarkably enough, Latin America, the greatest of them all - thanks to a number of major transit refiners operating in the Caribbean. All in all, it is the South that has the excess refinery output.

C.3 Scope for South-South cooperation

C.3.1 Trade

What with all developed regions except EE net importers of crude, oil-importing developing countries have traditionally been supplied by oil-exporting ones: in 1976, 94.5 per cent /on a dollar price basis/ of crude imported by the developing countries came from other developing countries, of which 64.7 % through interregional, 25.6 % through regional and 4.2 % through subregional channels. In petroleum products, on the other hand, the corresponding figures were only 69.7 % /from developing countries/, 39.5 % /interregional/, 30.8 % /regional/ and 29.8 % /subregional/. Also, products imports were worth $3.9 bn only, as compared with $23.4 bn for crude. These data are somewhat obsolete, but they reflect the correct proportions.+ It is submitted here that, by 1990, developing countries can supply 80 to 85 % of the product market in the developing world, and that crude:products turnover may shift to something like a 3:1 ratio as compared with 6:1 above. The developing-country market, crude and products taken together, may be expected to grow by 3 to 4 % a year between now and 1990, implying a total turnover of, at a very rough estimate, some $70 bil-

+ UNCTAD Secretariat, Statistics of Trade among developing countries by country and product, TD/B/C.7/36/Add.1,2,3. These tables count Rumania, Turkey and Yugoslavia as developing countries.

lion in 1990, in 1976 dollars.

C.3.2 Siting and expansion

Of the 254 countries and territories characterised as such in the UN Statistical Yearbook, 114 have refineries, more than have either metallurgical capacities in the modern sense or, a fortiori, petrochemical facilities. Of the 140 that have not, 227 have populations of less than one million. Of the remaining 23, 14 are land-locked. The remaining nine are Benin, Guinea, Cameroun, Mauritania, Haiti, Hong Kong, Papua New Guinea, Vietnam and Yemen. In Cameroun and Mauritania, refining is to begin soon. Of the nine, only Yemen, Papua New Guinea and Hong Kong had, in 1980, a per caput GNP exceeding $300.

The following conclusions emerge. /1/ A refinery site on tidewater is a considerable advantage, especially for transit refiners. /2/ A refinery on tidewater, close to a sizeable market, may be profitable even if not backed up by a domestic oil reserve /provided of course that refining margins are more or less normal/. /3/ Land-locked countries with small-size economies prefer to import products. /4/ Refinery output can, even using the most modern technology, be adapted to a country's particular product mix demand within limits only. If there is no ready market for the unwanted products, domestic refining may be more expensive than product imports. This is why Papua New Guinea, a medium-size economy among developing countries /population, 3 millions; per caput GNP in 1980, 780 dollars/ chose not to build a refinery; the reasons are explained in detail on p. 234 of Petroleum Economist, 1981. /5/ Finally, let us add a remark that does not follow from the figures: it is much cheaper to expand a refinery than to build a new, greenfield one.

All in all, one may expect that, between now and 1990, only two or three more developing countries will go in for petroleum refining, those on the territory of which new oil deposits will be discovered. Hence, most of refinery expansion in the developing world should be expected to take place in countries which already have some refining: in fact, the more they have, the more they will probably want to expand. Between 1975 and 1990, refining throughputs are expected to increase by a factor of 2.2 in Latin America, by a factor of 2.1 in NE, and by a factor of 2.5 in AS + IN. The African expansion may be around 1.6.

C.3.3 Technology

In the current atmosphere of cut-throat competition, when the most modern processes and equipment are wanted by all /new ways and means of catalysis; processes enhancing light and middle distillates recovery such as visbreakers, flexicokers, flexicrackers, hydrocrackers etc./, reliance on the developed market economies' engineering and consultancy specialists is considerable. Another advantage they have is a global market awareness and the techniques needed to adapt to changes. Hence, even though a modern refinery in, say, Brazil would need only about 20 % or less imports /project identification, basic engineering, some construction supervision, the most sophisticated equipment including computer control and automation, catalysis/, it is not expected that, up to 1990, developing countries will cooperate in refinery construction, the way they might in iron and steel and do in fertilisers, except in a fairly harsh delinking climate.

C.3.4 Other South-South cooperation

1 The surplus of the Cameroun refinery now coming on-stream is earmarked for Chad and the Central African Republic. /316/ +

2 The Brazilian Braspetro is prospecting for, and has struck oil in, Libya. /31/

+ The numbers in parentheses refer to the page numbering of the Petroleum Economist, 1981.

3 The Nouadhibou refinery of Mauritania is to be reactivated with Algerian assistance. /124/

4 The Asian Development Bank is part-financing refinery expansion and improvement in Burma /$5m out of a total cost of $7.8m/. /81/

5 India and the United Arab Emirates are to construct a 12 million tpy joint venture refinery at Mangalore, India. /82/

6 Indonesia has entered into a production-sharing agreement concerning an oilfield with Kodeco Energy Co. of the Republic of Korea. /273/

7 The Republic of Korea bought out Gulf Oil's share of the Ulsan refinery, assisted by a loan from the Al-Saudi Bank of Paris. /38/

8 Mexico is to help Cuba evaluate its offshore potential, and to participate in exploration in Costa Rica, possibly also in China, Panama, Peru, Colombia and Uruguay. /39/

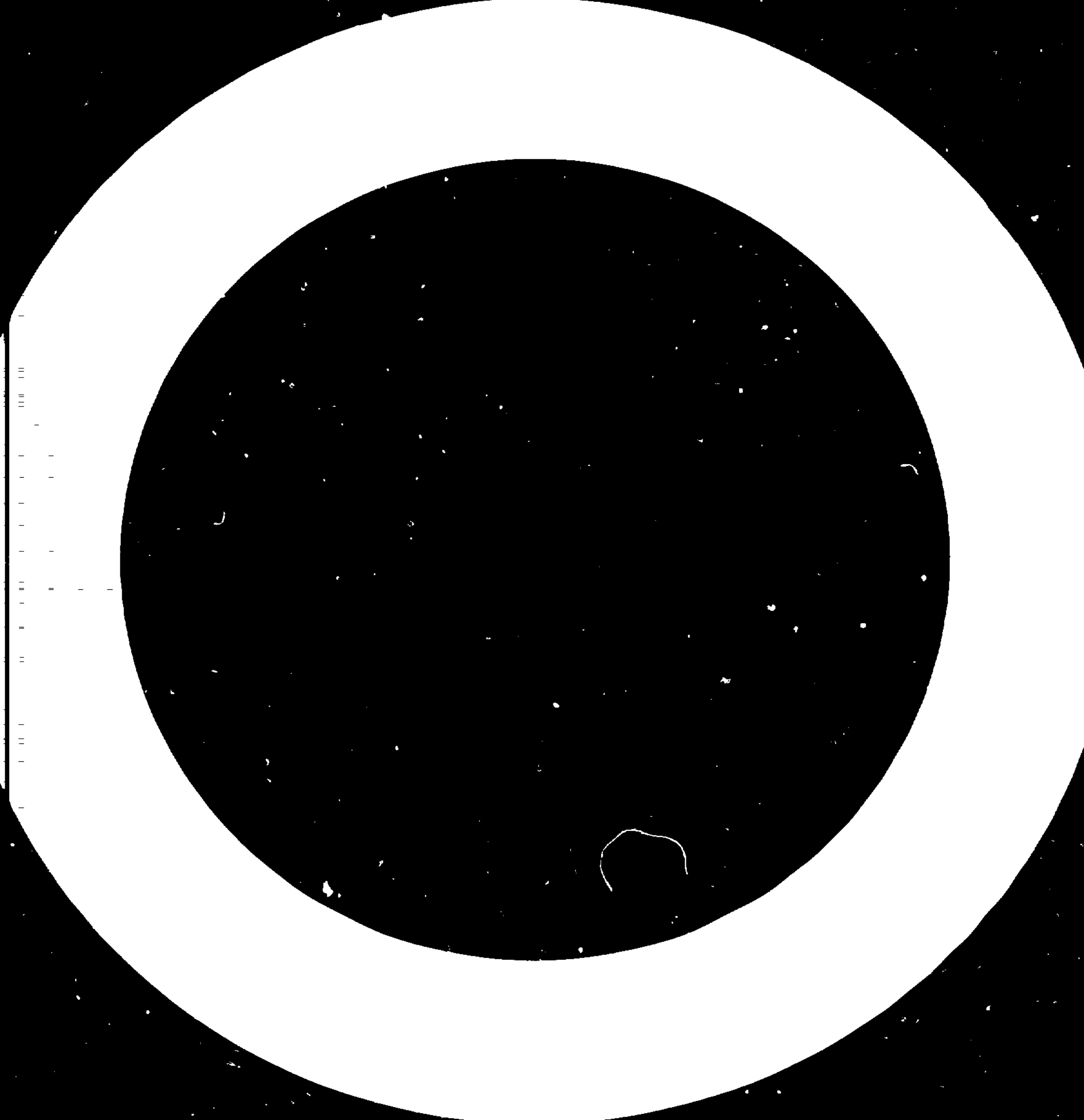
9 Mexico and Venezuela agreed to supply Central American and Caribbean oil-importing countries on concessionary credit terms. /410/

10 Kuwait, Saudi Arabia and Bahrein are to build a joint-venture hydrocracker in Bahrein, and have ordered a feasibility study. /408/

11 Kuwait intends to domestically refine half of its crude output by 1984, with the East African and Southwest Asian market in mind. /258/ It also intends to set up a company to further overseas exploration.

12 Apicorp, the Arab Petroleum Investment Corporation intends to finance development and refining in Arab and non-Arab countries. /189/

Significantly, petroleum refining does not figure among the goals of cooperation of AIP, the Asean Industrial Projects package, nor in "A Programme for the Industrial Development Decade for Africa /ID/287, 1982/, nor in any other document on South-South co-operation available to this writer. This is in stark contrast with the emphasis on cooperation in fertilisers. It seems as though the developing countries believed either that refineries can take care of themselves, or that they are still too much the beat of the developed market economy countries' corporations to be interfered with. Neither attitude is justified. UNIDO may, and should, take a hand in dispersing that attitude.



D Basic petrochemicals

The basic petrochemicals, to which discussion is to be confined here, are ethylene, propylene, butadiene, benzene, the xylenes and methanol. They are used to make plastics like polyethylene, high- and low-density; polypropylene, PVC and polystyrene; acrylic, nylon and polyester fibres; and SBR and polybutadiene rubber. We shall consider ammonia in the chapter on fertilisers.

The feedstocks used to make the basic petrochemicals include, on the one hand, refinery products such as naphtha, LPG /liquefied petroleum gases/, distillates in the diesel fuel range and refinery tail gases and, on the other hand, natural gas. Of these, only natural gas is a mineral resource; the availability of the rest depends on refinery capacity and product patterns.

D.1 Resource base - natural gas

For world natural gas production and proven reserves, cf. Table 6. The fact that, between 1970 and 1982, proven reserves more than doubled implies that the reserve picture reflects exploration effort rather than ultimate potential. In fact, until recently, a great deal of gas was a by-product of exploration for oil, and also something of a nuisance as most of it had to be flared. /For the flaring situation, cf. Table 7./ Most non-associated gas /gas not found in connection with oilfields/ was discovered in the last 10 to 15 years, in step with gas rising to a premium fuel in the industrialised world. As a by-product, there is a fast-rising market in LNG /liquefied natural gas/ shipped by refrigerated tanker: its growth is considerably hampered, though, by a lack of consensus on pricing principles.

The salient fact in Table 6 is that the South, with 42 % of proven reserves, gives only 13 % of commercial production. Accordingly, the entire industrialisation concepts in the countries that own gas deposits ought to be gas-based. Making petrochemicals, predominantly for export, does figure among the targets of most of them.

There is, as shown in the chapter on petroleum refining, ample excess refinery capacity standing idle these days. The product mixes of refineries being rather inflexible, however, the low utilisation of the refineries constrains feedstock production also to some extent. Thus the most important degree of freedom of basic petrochemical production today is the availability of natural gas.

D.2 Basic petrochemicals - the size of the problem

There is a considerable similarity between the quandary of refining and the problematique of basic petrochemicals production. To sum up:

- Capacity utilisation is very low, about 60 % in Western Europe. In 1980 and 1981, the industry lost $5bn. Demand growth is a mere 2 % per year.+
- The chemicals majors are pulling out of basic petrochemicals and going for specialty products whose profit margins are better.
- This means, here again, that two types of country will find themselves in a comparatively favourable situation: /1/ those which, having /or building/ an ample refinery capacity, or producing/flaring too much gas, and taking an optimistic view of the petrochemical markets, go in for basic petrochemicals exports; again, with the huge profits made on the crude or the gas, a negative petrochemicals margin is purely an accounting convention for them; and /2/ those who, needing more petrochemicals than they can currently produce, can build up petrochemicals capacity in the shelter of a domestic market. Here too,

+ The Economist, November 6, 1982, p. 20.

Table 7

World natural gas production and proven reserves, 1981
billion /thousand million/ cubic metres

Region	Production+ 1981	Proven reserves		
		1.I.1970	1.I.1982	as % of world
NA	628.60	9264	8184	9.6
WE	190.22	4160	4903	5.7
EE	519.43	9482	34457	40.5
JP	2.41	20	27	neg
OD	12.37	541	1038	1.2
LA	69.68	1651	5077	6.0
TA	1.42	184	1738	2.0
NE	65.60	11752	24587	29.1
IN	16.85	719	1190	1.4
AS	32.57	224	3028	3.5
OA	19.05	102	730	0.9
Total	1558.20	38099	84959	99.9++

Commercial, excluding flared or reinjected; mainly excluding field usage.

++ One tenth of a percent accounts for reserves negligible on a world scale.

Source: Petroleum Economist, August 1982, p. 319.

OPEC countries are likely to fall into the first group and big-economy developing countries into the second. The developed regions with excess petrochemicals capacity will be squeezed in the middle: another case of input starvation under the impact of the market forces.

Table 7

Gas flaring by the five greatest flaring countries

Country	Flaring, billion cu. m		Change, %
	1978	1979	
Saudi Arabia	30.3	37.8	+ 14.9
Nigeria	20.0	24.3	+ 21.2
Algeria	12.2	12.8	+ 4.8
Indonesia	8.7	10.8	+ 23.8
USSR	12.0	11.0	- 8.3
Totals	83.2	96.7	+ 16.2

NB. Total flaring in the world in 1979 amounted to 190 billion cu. m, 12.7 % of the total produced.

Source: Petroleum Economist, August 1980, p. 337.

D.3 World distribution of production and consumption

In order to avoid duplication of effort, the capacity, production and demand data, the latter forecast to 1990, have been taken from the Annexes to the Second World-Wide Study on the Petrochemicals Industry, ID/WG.336/3/Add.1, 20 May 1981. The relevant tables are reproduced in an Appendix. The only remark to be made in connection therewith is that production and demand are too evenly balanced for each of the two great world regions and do not reflect actual trading.

What is essential is the increase of demand for basic petrochemicals in the developing world between 1979 and 1990, which is

- 11.3 million tons or 420 % of 1979 demand for ethylene,
- 3.3 " " 280 % " " propylene,
- 1.2 " " 280 % " " butadiene,
- 3.7 " " 285 % " " benzene,
- 2.2 " " 275 % " " xylenes,
- 2.6 " " 280 % " " methanol.

The developing countries' demand will represent respectively 20, 12, 19, 16, 25 and 13 % of world demand in 1990.

D.4 Scope for South-South cooperation

D.4.1 Trade and transport logistics

International trade proportions of the six basic petrochemicals considered here are reflected well enough by OECD imports in 1979, exclusive of intra-EEC trade.

Chemical	Imports 10^3 tons	Share of developing world %	Share of CPEs %
Ethylene	87.7	22.0	-
Propylene	402.3	-	-
Butadiene	461.8	1.0	0.4
Benzene	611.9	7.2	17.9
Xylenes	757.2	7.1	5.6
Methanol	1119.8	50.1	7.6

The trade of ethanol is less by an order of magnitude. Ethanol is a gas of lowish boiling point+ that has to be transported in refrigerated tankers. Its transfer to shore is an operation requiring comparatively expensive equipment.

Propylene also is a gas at room temperature, but its boiling point is higher at - 48 °C and its handling so much simpler. Butadiene boils at - 4.5 °C and is a liquid at a fairly low pressure. All the others are liquid at room temperature.

Developing countries' demand and output were in statistical balance in 1975 in ethylene and propylene; there was a slight /10 000 ton/ deficit in butadiene and slightly bigger ones /120 thousand tons and 40 000 tons respectively/ in benzene and xylenes. The deficit in methanol was 110 000 tons. By 1979, the buta-

+ - 104 °C.

diene deficit had disappeared, and the others had evolved as follows: benzene, 120 000 tons; xylenes, 140 000 tons; methanol, an excess of 380 000 tons. However, exports to the OECD group of countries made up, in 1979,

- 19.3 thousand tons of ethylene,
- 4.8 " " butadiene,
- 44.3 " " benzene,
- 53.4 " " xylene,
- 561.2 " " methanol.

/No propylene went from the developing countries into the OECD group./ Actual deficits were that much bigger.

Short-circuiting these flows within the South is the most clear-cut option of South-South cooperation in basic petrochemicals.

D.4.2 Siting and expansion

Whereas, as shown in the chapter on petrochemicals, countries above a population of one million without a refinery are the exception rather than the rule in the developing world, the numbers of developing countries with basic petrochemicals facilities is expected to evolve as follows.

Region	Ethylene			Propylene			Butadiene			Xylenes			Benzene			Methanol		
	79	84	87	79	84	87	79	84	87	79	84	87	79	84	87	79	84	87
	number of producing countries																	
6 LA	6	6	9	5	5	7	3	3	4	4	4	7	4	4	8	3	3	4
7 TA	-	-	1	-	1	1	-	-	-	-	-	-	-	1	1	-	-	-
8 NE	3	5	8	1	2	2	1	2	2	-	2	3	-	1	2	2	5	6
9 IN	1	1	2	1	1	1	1	1	1	2	2	2	1	1	1	-	1	1
10 AS	2	3	6	2	3	3	1	1	2	1	1	3	1	1	3	1	1	4
11 OA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Totals	13	16	27	10	13	15	7	8	10	8	10	16	7	9	16	7	11	16

Source: ID/WG.336/3. For details see Appendix.

The countries that have producing facilities for the full range now are India, the Republic of Korea, China, Argentina, Brazil and Mexico. By 1987, only one other country, Iran, is likely to have the full range of facilities.

By far the largest number of countries will have ethylene facilities; the probable reason is the awkward transport logistics of ethylene /see below/. Butadiene is at the opposite end, probably because its downstream product, synthetic rubber, is not felt to be attractive by most developing-country producers.

To satisfy demand in a non-hydrocarbon-producing country in thermoplastics, synthetic fibres and/or synthetic rubbers it is, provided the country possesses or can build a refinery, probably simplest to ship crude oil there and there to refine the feedstock out of it. Second-best is probably to ship feedstock and to produce the basic petrochemicals in the country. Both solutions come up against the wish of the hydrocarbon-producing countries to increase the value added to their hydrocarbons before exportation. Thus international movements of basic petrochemicals should be expected to increase at the expense of feedstock /and crude/ movements. Most of the increase will probably be in trade with the North, but a certain share also in intra-South trade. The greatest increase in world movement will be in ethylene /12 %, partly to catch up with the low demand of today/ and in methanol /27 %; cf. ID/WG.336/3, p. 72./ The developing countries with the most ambitious plans to export include Qatar, Libya, Kuwait, Saudi Arabia and Singapore for ethylene, and those except Kuwait and Singapore for ethanol. Further export-orientated capacities may be expected to come onstream by 1990 in Iraq, Iran, Indonesia, the Republic of Korea, Brazil, Mexico and Venezuela. By 1990, the South may well attain global statistical self-sufficiency.

D.4.3 Technology

Much of what has been said about petroleum refining holds here.

D.4.4 Other South-South cooperation

"A programme for the Industrial Development Decade for Africa" /ID/287, p. 108/ states that "attempts would be made, particularly by those countries with petroleum and natural gas resources to refine and process those resources into petrochemicals, especially plastics, synthetic fibres, rubbers and detergents". It also recommends the biomass route of petrochemicals manufacturing for countries not endowed with fossil hydrocarbons.

The AIP /ASEAN Industrial Projects/ package does not include non-fertiliser petrochemicals.

Industrial allocation schemes in the Andean Group do include petrochemicals as a third priority after iron and steel and fertiliser.

Just as in the case of petroleum refining, it is important to boost a hitherto greatly inadequate awareness of the cooperation potential in petrochemicals within the South.

E Mineral fertilisers

This group includes <u>in the strict sense</u>

- potash fertilisers which are produced simply by a process of mineral beneficiation /which involves the differential dissolution or flotation of undesirable accompanying salts/, albeit a fairly sophisticated one as beneficiation operations go;
- phosphate fertilisers made out of phosphate rock /phosphorite/ or apatite, by a chemical process of medium sophistication, comparable in this respect with alumina refining.

Since most phosphate fertiliser is prepared by a process which uses sulphuric acid, sulphur as the raw material of sulphuric acid shall also be discussed briefly.

Nitrogen fertilisers are mineral fertilisers only <u>in the broad sense</u> of the term. They are typically made nowadays out of natural gas or some petroleum refinery product such as naphtha, but other fossil fuels /crude oil; coal/ are also possible sources. There is also an electrochemical process simply using the nitrogen content of air and electricity, but no fossil fuel; it is little used today. Nevertheless, for completeness, and also because nitrogen fertilisers are petrochemical products in a way if prepared from a petroleum product or gas, we shall include them into the discussion.

E.1 The resource base

E.1.1 Potash fertilisers

World potash reserves are abundant but very unevenly distributed: three regions have none and four more have less than two per cent of world reserves each. North America and the

Table 8

World potash reserves and resources, expressed as K_2O
Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	3000	33.0	73000	50.5
2 WE	680	7.5	5740	4.0
3 EE	4800	52.9	53000	36.7
4 JP	-	-	-	-
5 OD	-	-	20	0.0
6 LA	60	0.7	380	0.3
7 TA	20	0.2	200	0.1
8 NE	300	3.3	1100	0.8
9 IN	-	-	-	-
10 AS	120	1.3	10050	7,0
11 OA	100	1.1	1000	0.7
Total	9080	100.0	144490	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

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two European regions provided in 1978 more than 95 % of world potash production. This is probably the mineral with the reserve distribution biased most heavily against the South. Even so, Southern reserves are sufficient to cover current Southern consumption for some 170 years, which reveals two things: /1/ potash fertiliser use in the South should be greatly expanded, and /2/ at a pinch, the Southern reserves, which are probably just slightly more expensive to work than the Northern ones, could be brought into production. Also, the Near East is a substantial net exporter.

Table 9

World potash production, 1978, and capacity, 1978 and 1985, actual weight

Region		Production in 1978		Capacity			
				1978		1985	
		000 t	%	000 t	%	000 t	%
1	NA	8377	32.2	9995	32.8	11250	30.8
2	WE	5208	20.0	6755	22.2	6770	18.5
3	EE	11516	44.2	12670	41.5	15900	43.5
4	JP	-	-	-	-	-	-
5	OD	-	-	-	-	-	-
6	LA	17	0.1	20	0.1	320	0.9
7	TA	-	-	-	-	-	-
8	NE	732	2.8	730	2.4	1970	5.4
9	IN	-	-	-	-	-	-
10	AS	-	-	-	-	-	-
11	OA	150	0.6	310	1.0	310	0.8
Totals		26000	100.0	30480	100.0	36520	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding.

Table 10

World phosphate reserves and resources, actual weight
Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	1800	5.2	9250	7.1
2 WE	15	0.0	60	0.0
3 EE	4500	13.1	12000	9.3
4 JP	-	-	-	-
5 OD	3000	8.7	12000	9.3
6 LA	3000	8.7	7000	5.4
7 TA	330	1.0	930	0.7
8 NE	20500	59.5	65500	50.5
9 IN	100	0.3	300	0.2
10 AS	100	0.3	230	0.2
11 OA	1100	3.2	22400	17.3
Totals	34445	100.0	129670	100.0

Source: Mineral Facts and Problems, op. cit.

E.1.2 Phosphate fertilisers

E.1.2.1 Phosphorite/apatite

The Near East is the home of the bulk of these reserves, which are also fairly abundant world-wide. Apart from that, the reserve distribution is comparatively uniform; only Japan has none /not even any resources/, and WE is very poorly provided. NA with a modestish reserve position is the greatest producer of phosphate rock in the world, the second most important exporter of phosphate rock, and the first net exporter of both phosphoric acid and, by a very wide margin, of phosphate fertiliser; this reveals that, when reserves are very abundant, production and ex-

Table 11

World phosphate rock production, 1978, and capacity, 1978 and 1985, actual weight

Region		Production in 1978		Capacity			
				1978		1985	
		10^6 t	%	10^6 t	%	10^6 t	%
1	NA	50.0	40.2	52.6	35.1	71.7	39.6
2	WE	0.1	0.0	0.1	0.0	0.1	0.0
3	EE	23.8	19.1	24.8	16.6	30.0	16.6
4	JP	-	-	-	-	-	-
5	OD	3.0	2.4	4.0	2.7	3.0	1.7
6	LA	1.5	1.2	1.7	1.1	3.8	2.1
7	TA	5.4	4.3	7.6	5.1	8.4	4.6
8	NE	28.6	23.0	45.4	30.3	50.7	28.0
9	IN	2.0	1.6	2.3	1.5	1.3	0.7
10	AS	3.9	3.1	4.5	3.0	3.0	1.7
11	OA	6.3	5.1	6.7	4.5	9.0	5.0
Totals		124.6	100.0	149.7	100.0	181.0	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

port figures may be entirely divorced from the reserve situation. Just as remarkably, Eastern Europe, with the second strongest reserve position, is after WE the second greatest phosphate rock importer, which further corroborates our thesis. All in all, the reserve situation is fairly balanced, and so is also the production situation, not only North to South but, with some exceptions, also region by region.

E.1.2.2 Sulphur

A reserve distribution biased somewhat in favour of the

Table 12

Identified world sulphur reserves and resources,

Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	425	24.1	2580	40.4
2 WE	290	16.4	1065	16.6
3 EE	400	22.7	1300	20.4
4 JP	10	0.6	50	0.8
5 OD	20	1.1	30	0.5
6 LA	125	7.1	215	3.3
7 TA	20	1.1	20	0.3
8 NE	400	22.7	800	12.5
9 IN	-	-	-	-
10 AS	50	2.8	250	4.0
11 OA	25	1.4	75	1.2
Total	1765	100.0	6385	100.0

Source: Mineral Facts and Problems, op. cit.

North; a production pattern biased much more so, in keeping with the fact that industrial economies need disproportionately more sulphur. Reserves are fairly abundant and growing: the preoccupation with acid rain and other sulphuric acid pollution increasingly makes it worth the while of the users of fossil fuels to recover the sulphur values contained in those.

E.1.3 Nitrogenous fertilisers

With the exception of the Near East, NA, WE, EE and Japan are the only net exporters of nitrogen fertilisers; let us recall, however, that three of these regions /NA, WE and EE/ are the greatest producers of natural gas, and only Japan relies heavily on

Table 13

World sulphur production, 1978, and capacity, 1978 and 1985, million tons

Region	Production in 1978		Capacity			
			1978		1985	
	10^6 t	%	10^6 t	%	10^6 t	%
1 NA	18.4	34.5	21.0	33.3	27.0	34.6
2 WE	9.1	17.0	11.8	18.7	12.0	15.4
3 EE	16.0	30.0	16.5	26.2	18.0	23.1
4 JP	2.7	5.1	4.0	6.3	6.0	7.7
5 OD	0.5	0.9	0.8	1.3	0.9	1.1
6 LA	2.6	4.9	3.6	5.7	4.5	5.8
7 TA	0.4	0.7	0.6	1.0	0.6	0.8
8 NE	1.4	2.6	2.0	3.2	6.0	7.7
9 IN, 10 AS	0.6	1.1	1.0	1.6	1.0	1.3
11 OA	1.7	3.2	1.7	2.7	2.0	2.6
Totals	53.4	100.0	63.0	100.0	78.0	100.0

imported feedstock. The gas reserves of the Near East provide, even with all other kinds of feedstock disregarded, a more than adequate basis for nitrogen fertiliser production far exceeding the present and future needs of the South; making fertilisers would be one of the sensible ways of using gas that is being flared today.

E.2 Trade potential

Referring to Table 16, Totals /2/, the developing market-economy group is, remarkably enough, expected to become practically self-sufficient in nitrogen fertiliser by 1986/87. It and the EE group will compete for the market outlets represented by the deficits of the developed market economies and of OA. The excess capacity which the developing market economies may confidently be

Table 14

World consumption and surplus/deficit of fertilisers

Million tons of $N/P_2O_5/K_2O$

Region[□]	C 81/82	S 81/82	C 86/87	S 86/87	C 81/82	S 81/82	C 86/87	S 86/87	C 81/82	S 81/82	D 86/87	S 86/87
	Nitrogen fertiliser				Phosphate fertiliser				Potash fertiliser			
1 NA	11.70	1.27	14.30	-0.58	4.90	5.15	5.94	4.98	5.93	1.71	6.77	4.06
2 WE	9.95	-0.13	11.50	-0.49	5.37	0.61	6.01	-0.15	5.28	-0.47	5.98	-0.66
3 EE	13.33	4.06	17.00	5.19	9.02	-1.00	11.14	-1.00	8.53	2.08	10.67	3.86
4 JP 5 OD	1.43	0.21	1.69	-0.09	2.37	0.70	1.98	0.19	1.05	-0.22	1.16	0.03
6 LA	2.85	-0.11	3.64	0.71	2.52	-1.08	3.75	-1.79	1.26	-1.24	2.19	-1.95
7 AF	0.69	-0.63	1.01	-0.32	0.51	1.12	0.72	1.99	0.26	-0.26	0.36	-0.36
8 NE	1.81	0.12	2.60	0.70	1.06	-0.38	1.60	-0.17	0.06	-0.06	0.08	0.38
9 IN 10 AS	7.26	-1.96	10.12	-1.11	2.55	-1.15	3.73	-2.00	1.28	-1.28	1.68	-1.68
11 OA	12.48	-1.72	14.09	-2.20	3.26	-0.51	3.80	-0.52	0.70	-0.68	0.89	-0.87
Totals												
/1/	23.08	1.35	27.49	-1.16	12.64	6.46	14.93	4.93	12.26	1.02	13.91	3.43
/2/	12.61	-2.58	17.37	-0.02	6.64	-1.48	9.80	-1.98	2.86	-2.84	4.31	-3.61
/3/	25.81	2.34	31.09	2.99	12.28	-1.51	14.94	-1.52	9.23	1.40	11.56	2.99
/4/	61.50	1.11	75.95	1.81	31.56	3.47	39.68	1.42	24.35	-0.42	28.80	2.81

□ The regionalisation differs somewhat from that of the UNITAD model: /1/ WE does not include Turkey; /2/ JP+OD includes Israel; /3/ AF includes, and hence, NE does not include, Africa North of the Sahara; /5/ IN+AS includes, in addition to developing Oceania, also Bermuda, Greenland, and St Pierre and Miquelon for statistical convenience /they do not matter in any case/.

Remarks. C denotes consumption; S denotes surplus or /if negative/ deficit. /1/ is the totals for developed, /2/ for developing market economies, /3/ for all CPEs as another statistical convenience, and /4/ is world totals.

Source: A World Bank draft dated Sep 2, 1982 for FAO's Current World Fertilizer Situation and Outlook, 1981/82 - 1986/87.

Table 15

Movements of some fertiliser minerals and intermediates

Region		Rock phosphate, 10^3 t[§]			Phosphoric acid, net imps., P_2O_5 10^3 tons[+]	Ammonia, net imports, N 10^3 tons[+]
		imps.	exps.	net imps.		
		1979	1979	1979	1979	1979
1	NA	4152	14787	-10635	-728.2	- 317.8
2	WE	23893	44	23849	194.7	1327.6
3	EE	10457	4130	6327	436.2	-1402.2
4	JP	2828	-	2828	67.4	- 47.2
5	OD	3729	122	3607	-476.7	-
6	LA	2239	48	2129	535.4	- 793.9
7	TA	61	4592	- 4531	-	26.1
8	NE	552	25074	-24522	-552.8	- 217.6
9	IN	1758	-	1758	265.2	121.2
10	AS	2354	3634	- 1280	26.9	51.4
11	OA	1110	-	1110	-	-
Totals		53133	52431	702[%]	-231.9[□]	-1252.4[□]

[+] These figures are liable to be incomplete

[%] Errors, omissions and stock movements

[□] Errors, omissions, stock movements and incomplete data

[§] Actual weight

Source: Author's calculations based on FAO Fertilizer Yearbook, 1981, Vol. 30, Rome 1981. FAO Statistics Series No. 36.

expected to develop by 1990 will depend on the success or otherwise of that competition.

As to phosphate fertiliser, a medium-sized surplus in AF /which, it is to be recalled, contains Africa North of the Sahara in this particular case/ is more than offset by a slight shortage in NE and sizeable ones in LA and IN+AS. This and the CPEs' shortfall

Table 16

Phosphate fertiliser movements related to consumption, crop year 1979/1980, P_2O_5

Region		Exports 10^3 t	Exports %	Imports 10^3 t	Imports %	Net imports 10^3 t	Net imports % of consumpt.	Consumption 10^3 t	Consumption %
1	NA	3773	56.01	392	6.83	-3381	-61.3	5517	17.75
2	WE	1560	23.16	2425	42.27	865	12.7	6789	21.84
3	EE	466	6.92	428	7.45	- 39	- 0.4	8646	27.82
4	JP	30	0.45	97	1.69	67	8.0	831	2.67
5	OD	35	0.53	38	0.66	2	0.1	1763	5.67
6	LA	71	1.06	935	16.30	863	34.6	2491	8.02
7	TA	10	0.15	155	2.70	145	63.7	228	0.73
8	NE	465	6.91	295	5.13	- 171	-28.1	610	1.96
9	IN	-	-	539	9.39	538	38.0	1419	4.57
10	AS	322	4.78	354	6.17	32	4.7	672	2.16
11	OA	2	0.03	81	1.41	79	3.7	2115	6.80
Totals		6736	100.00	5736	100.00	-1000+	n.a.++	31080	100.00

+ Errors, omissions and stock movements

++ not applicable

Source: Author's calculations based on FAO Fertilizer Yearbook, 1980, Vol. 30, Rome 1981. FAO Statistics Series No. 36.

is, to all intents and purposes, covered by the North American surplus on its own. There is a sizeable potential of intra-South trade here if the phosphate reserves of Africa and the Near East are provided with adequate fertiliser-making facilities to satisfy Latin American and Asian demand /and also to compete for the CPEs' demand: the Meskala phosphate mine-and-fertiliser-plant complex now being built in Morocco with finance from, and sales contracts to, the USSR is a case in point/. The problem is that the Latin American and Asian demand is backed up by the weakest buying power, comparatively speaking; it is accordingly liable to constitute the downmarket end and to fluctuate more than the other parts of the market in a downturn.

Table 17

Potash fertiliser movements related to consumption, crop year 1979/1980, K_2O

Region	Exports 10^3 t	Exports %	Imports 10^3 t	Imports %	Net imports 10^3 t	Net imports % of consumpt.	Consumption 10^3 t	Consumption %
1 NA	7383	47.15	4928	32.05	-2455	-41.1	5973	25.74
2 WE	2752	17.58	3619	23.54	867	15.2	5716	24.37
3 EE	4731	30.21	2281	14.83	-2450	-34.1	7190	30.66
4 JP	-	-	767	4.99	767	104.2	736	3.14
5 OD	-	-	370	2.40	370	102.9	359	1.53
6 LA	17	0.11	1580	10.28	1563	98.3	1590	6.78
7 TA	-	-	124	0.80	124	84.3	147	0.63
8 NE	777	4.96	109	0.71	- 667	-537.5	124	0.53
9 IN	-	-	559	3.64	559	90.2	620	2.64
10 AS	-	-	644	4.19	644	110.4	583	2.49
11 OA	-	-	395	2.57	395	95.3	414	1.77
Totals	15660	100.00	15376	100.00	- 284+	n.a.□	23453	100.00

\+ Errors, omissions and stock movements

□ Not applicable

Source: Author's calculations based on FAO Fertilizer Yearbook, 1980, Vol. 30, Rome 1981. FAO Statistics Series No. 36.

The potash fertiliser situation reflects the reserve picture: with the exception of the Near East, every developing region has a deficit, whereas NA and EE are regions with large surpluses. Foreseeable changes in the potash supply of the South may include the recovery of potash from the Dead Sea by Jordan, a boost to Israeli production from the Dead Sea and to Chilean production from the Salar de Atacama, the reopening of the flooded potash mine in the PR of the Congo and the possibility of Brazil opening a mine at the Taquari-Vassouras deposits in Sergipe County.+ For all that, intra-South trade potential in potash fertiliser appears slight.

\+ US Bureau of Mines, Mineral Facts and Problems, op. cit., p. 709.

Table 18

Nitrogen fertiliser movements related to consumption, crop year 1979/1980, N

Region	Exports 10³ t	Exports %	Imports 10³ t	Imports %	Net imports 10³ t	Net imports % of consumpt.	Consumption 10³ t	Consumption %
1 NA	3316	27.47	2484	19.97	- 832	- 7.5	11149	19.49
2 WE	4058	33.62	3176	25.54	- 881	- 8.2	10789	18.86
3 EE	2316	19.19	269	2.16	-2047	-17.0	12009	21.00
4 JP	773	6.40	44	0.35	- 729	-93.8	777	1.36
5 OD	33	0.27	80	0.64	47	7.1	657	1.15
6 LA	205	1.70	1367	10.99	1162	43.5	2670	4.67
7 TA	5	0.04	303	2.44	298	74.0	404	0.71
8 NE	885	7.33	671	5.39	- 215	-17.8	1208	2.11
9 IN	28	0.23	1922	15.45	1895	41.5	4565	7.98
10 AS	417	3.45	568	4.55	149	8.5	1760	3.08
11 OA	36	0.30	1558	12.53	1523	13.6	11212	19.60
Totals	12070	100.00	12439	100.00	369⁺	n.a.□	57200	100.00

⁺ Errors, omissions and stock movements

□ Not applicable

Source: Author's calculations based on FAO Fertilizer Yearbook, 198 , Vol. 30, Rome 1981. FAO Statistics Series No. 36.

E.3 Siting and expansion

Fifteen developing countries export phosphate rock; 39 produce and export phosphate fertiliser; 47 produce and 28 export nitrogen fertiliser; but only four produce potash fertiliser /Congo, Chile, China and Israel/, and only two /Chile and Israel/ export some. Potash fertiliser making being the least sophisticated of these operations, the constraint operating here is the shortage of viable reserves.

Table 19

New fertiliser production capacities under construction, for startup between 1980 and 1986+

Region	Ammonia§	Phosphoric acid□
	thousand tons	
1 NA	1767	2024
2 WE	3039	537
3 EE	6690	2045
4 JP	-	-
5 OD	221	270
6 LA	2634	623
7 TA	508	-
8 NE	3833	2795
9 IN	4560	278
10 AS	678	-
11 OA	446	-
Totals	24376	8572

+ Up to 1983 in their bulk; the data are liable to be incomplete

□ Wet process, P_2O_5 § N content

Source: Author's calculations based on FAO Fertilizer Yearbook, 1980, Vol. 30, Rome 1981. FAO Statistics Series No. 36.

To judge by the number of countries engaged in it, fertiliser making is a somewhat more sophisticated operation than petroleum refining /which is practised by 73 developing countries/ and a less sophisticated one than the making of basic petrochemicals. There is some truth in this, but the more important fact is that refinery products /alas/ are a more immediate need, and thus also more likely to sell under their own steam, than fertilisers, in the case of which marketing probably requires more sophistication in a developing-country setting than manufacturing. There is no immediate comparison here with basic petrochemicals which are manufacturers' inputs.

Capacity development up to 1986/8 is presented in Table 14. It emerges that, of world capacity increment, 44 % will be in the South in nitrogen fertiliser; 46 % in potash fertiliser; and 37 % in potash fertiliser. This, disregarding the OA group, results in self-sufficiency in nitrogen fertiliser, but the need to import phosphate and potash fertiliser increases, whether or not the OA group is included. All these tendencies are expected to continue up to 1990. The inferences concerning South-South co-operation have been drawn on pp. 41-45.

E.4 Technology

Urea making is considered today the technologically most demanding process and urea plant construction the technologically most demanding fertiliser plant building operation. Yet[+] a NIC would probably want only about a 5 % contribution, which includes the basic engieering, from a company of the North, and could probably dispense with that too under delinking.

On the other hand, in both phosphate and potash mining, especially in the solution mining of potash, systems consultancy including the assessment of deposits quality and viability, of mining and beneficiation technology, the optimisation of haulage patterns, of plant siting etc. are among the indispensable prerequisites to taking the right project decisions whenever international competitiveness is at stake. Accordingly, preparing such assessments requires considerable international experience: it is probably less easy to find in even the most developed developing countries than factory engineering and construction expertise. Of the UN family, UNDP and DTCD may be approached for assistance. DTCD in fact does have concrete project experience in phosphate.

+ The author is indebted to Messrs. Fernando Angulo and Jafar Abdul Ghani of UNIDO for consultations on this point.

E.5 Other issues of South-South cooperation

"Planning fertiliser production and marketing on a regional basis has many advantages... a substantial saving in capital and operating cost can result when the planning is done on a regional rather than a national basis... When regional cooperation is not feasible, bilateral or trilateral agreements may be useful."+ Perhaps in no other manufacturing sphere is South-South cooperation so developed and so efficacious as in fertiliser.

In many developing countries, the procurement and distribution of fertiliser is a quasi-public concern which is accordingly fairly extensively institutionalised, with more or less state sponsorship as a rule. Let us cite here just

- the Fertilizer Association of India,
- Fertimex /ex-Guanos y Fertilizantes/ of Mexico.

There are also regional and interregional associations, such as

- ADIFAL, the Asociacion para el Desarrollo de la Industria de los Fertilizantes de America Latina,
- AFCFP, the Arab Federation of Chemical Fertilizer Producers,
- ISMA, the International Phosphate Industry Association /the acronym refers to its former name, International Superphosphate Makers' Association/, etc.

All of these have some cooperation with UNIDO.

India provides a good example of South-South cooperation in fertiliser industry training. The key organism thereof is the Fertiliser Association of India, the representative body of the fertiliser industry in the country. Training programmes are offered in marketing, agricultural sciences, production technology, in-

+ UNIDO: Fertilizer Manual, Development and Transfer of Technology Series No. 13, New York, 1980, ST/CID/15.

cluding maintenance and instrumentation, also advertising and sales promotion. Courses have been attended by participants from Afghanistan, Bangla Desh, Egypt, Indonesia, Iran, Iraq, Jordan, Kuwait, Malaysia, Nepal, Saudi Arabia, South Korea and Sri Lanka. In both attendance and tradition, marketing and distribution logistics courses surpass all others. The countries represented being in their bulk heavily populated ones greatly dependent on agriculture, this emphasis is to be very specially commended.

In Senegal, the fertiliser company SIES has operated a 130 000 tpy complex NPK fertiliser plant since 1968, essentially for domestic use. In 1977, a project for a regional-interregional fertiliser project was mooted, with technical assistance from the French "Enterprise Minière et Chimique". The plant is to produce phosphoric acid and phosphate fertiliser using Senegalese rock phosphate and Polish sulphur. Shareholders are slated to include the Ivory Coast, Cameroun and Nigeria; the latter is expected to pay for its purchases with deliveries of ammonia. India has also stated its interest in the purchase of phosphoric acid. The project is to produce 1700 tpd sulphuric acid, 600 tpd phosphoric acid and the fertilisers triple superphosphate, mono- and diammoniumphosphate, with a total P_2O_5 content of 300 tpd. The fertiliser would find a wide distribution in Western, Central and Equatorial Africa, in Madagascar and Réunion. The International Finance Corporation and the Banque Islamique du Développement would be two of the shareholders. Other Arab finance may contribute credits. Apart from this project, SIES is organising training courses for the maintenance technicians of the Nigerian Federal Superphosphate Fertiliser Co. Ltd of Kaduna.+

+ UNIDO: Co-operation among developing countries in the fertilizer industry, ID/WG.322/1, 11 June 1980.

China is a remarkable example of self-reliance vs. technology absorption in fertilisers. In nitrogen fertiliser, an autonomous technology base capable of developing large, medium-sized and small plants using coal as a feedstock was developed; even the large plants were, however, smallish by international standards. Ammonium sulphate and nitrate was produced in the large and medium-sized plants and ammonium bicarbonate and aqueous ammonia in the small ones. Both the engineering and the equipment used were entirely domestic. Subsequently, numerous new plants were built using natural gas or refinery residue as a feedstock; urea and ammonium chloride began to be produced. In the early 1970s, however, it was realised that the fertiliser needs of the country could not be economically satisfied in this way: the decision was taken to build 13 large-scale nitrogen fertiliser plants on a semi-turnkey basis calling in foreign contractors. Simultaneously, however, the construction of the old-style plants continued, with much larger unit sizes than before. Yet the thirteen big modern plants were built in slightly more than six years.

Owing to the unequal endowments in raw materials, fertiliser production in China exhibits a considerable imbalance: against 7.6 million tons of N, only one million tons of P_2O_5 and about 50 000 tons of K_2O are being produced a year. The phosphate fertiliser industry was also developed on a self-reliance basis. The products comprise superphosphate and Ca-Mg phosphate. +

Geological, mining, minerals beneficiation expertise for phosphate rock and potash is being offered by the Instituto Mexicano del Petroleo and Fertimex of Mexico.

Mexico also offers training in ammonia, ammonium sulphate and nitrate, sulphuric, nitric and phosphoric acid, normal and triple supherphosphate, DAP and NPK plants. +

+ Ibidem.

Perhaps the most fascinating case of industry allocation is that of AIP, the ASEAN Industrial Projects. AIP involves the construction of two urea facilities, in Indonesia and Malaysia respectively, one superphosphate-ammonium sulfate fertiliser project in the Philippines, and a study in course concerning the development of potash deposits in Northeast Thailand and their conversion into potash fertiliser. In every one of these projects, the host country has 60 % equity, and each of the other four ASEAN countries has 10 %. For details cf. "The Development of the ASEAN Industrial Projects /AIPs/, by UNIDO Consultant Mohamed Ariff, UNIDO/IS.281 of 25 January 1982.

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In 1976, South-South trade in some fertiliser materials was characterised by the following figures+ in dollar terms:

Item	Southern exports' share of Southern imports	of which:	interregional	regional	subregional
	%		%	%	%
Ammonia	34.4		18.6	7.1	8.7
Nitrogen fertiliser	22.1		13.3	6.0	2.8
Phosphate fert.	24.0		13.3	8.9	1.8

South-South interregional phosphate rock trade currently includes Morocco to Latin America and Asia, Israel and Jordam to Asia, Senegal to Asia, and the Pacific islands to Indonesia, the Republic of Korea, Malaysia and Singapore.

\+ Statistics of trade among developing countries by country and product, TD/B/C.7/36/Add.3, op. cit. Rumania, Turkey and Yugoslavia figure as developing countries.

F Metallurgy

We shall consider here

- iron and steel under ferrous metallurgy, and
- aluminium copper, lead and zinc and tin under non-ferrous metallurgy.

An idea of the relative importance of these metals is provided by the following table. The data refer to the year 1978.

Table 20

Metal	World production	Price+	Value produced	Growth rate++
Crude steel	710 mion t	$ 326	$282.5 bn	2.65 %
Aluminium	14 " "	$1000	$ 14.0 bn	5.2 %
Copper	8.6 " "	$1200	$ 10.3 bn	3.6 %
Lead	3.4 " "	$ 610	$ 2.1 bn	2.9 %
Zinc	5.6 " "	$ 560	$ 3.1 bn	1.9 %
Tin	0.2 " "	$11430	$ 2.3 bn	0.9 %

+ US yearly average price for 1978, per metric ton

++ Yearly average, forecast, 1978-2000, for primary metal output

Source: Mineral Facts and Problems, 1980, op. cit.

Steel is seen to be in a class of its own at the top; so is tin, at the bottom. Aluminium and copper form a second league, lead and zinc a third, but the difference between these two leagues is comparatively small. Aluminium stands out in regard of forecast growth rate; so again does tin at the other extreme.

As a rule of thumb it follows from the above that it makes the most sense to set up distributed /subregional or country-by-country/ production centres in the case of steel, whereas in the case of tin, with its high unit price and small tonnage, concentrated production in just a few countries entails no particular disadvantage /the less so since this also fits the resource pattern/. The other four metals fall in between these extremes.

F.1 Ferrous metallurgy

F.1.1 The processes

Conventional iron-making is by the blast furnace route, the two essential raw materials of which are iron ore as a metal source and coke as a reductant. A coking grade bituminous coal is required to make coke. The output of the blast furnace is pig iron, the bulk of which is used to make steel. Most of the rest is made into objects of cast iron in foundries. Depending on the process, 400 to 700 kg of coke is consumed per ton of pig. The blast furnace route is denoted BF.

Pig iron is converted into steel in an electric, an open-hearth or Siemens-Martin, a basic oxygen or LD, or some other furnace. The first three types made up more than 99 % of world steel production in 1976, but with the open-hearth furnace in rapid decline. We shall accordingly consider here only the basic oxygen furnace /BOF/ and the electric furnace /EF/. The inputs into all these furnaces include pig iron and iron or steel scrap. Typically, about 30 % scrap and 70 % pig is fed to a BOF and anything up to 100 % scrap to an EF.

Big modern steelworks use the BF/BOF route. The annual output of a big works is in the one to ten million tons range. It is therefore too big for the small and most medium-sized developing countries.

One up-and-coming non-conventional route of iron-making is direct reduction /DR/. The process uses high-grade iron ore as a source of metal and some fossil fuel /coal, coking or not, possibly even better grade subbituminous; natural gas, etc., or possibly charcoal/ as a reductant. Its product, called sponge iron, is an excellent scrap substitute in either the BOF or the EF. The advantage of the DR/EF combination for developing countries is that economical sizes may be as small as 200 000 or even 50 000 tpy. The steel produced by the DR/EF route is, if anything, better-grade than BF/BOF output.

Blast furnaces using charcoal as a reductant have been developed in Brazil above all /cf. UNIDO/IOD.228/Revl.1/. These also may be economical in sizes of 150 000 or even 50 000 tpy of pig output. If fed a high-grade iron ore, they produce very pure pig. The principal problem with them is that they either require a large-scale forestry operation, which is not that much cheaper than imported coke, or else entail a degree of deforestation that is hard to justify.

Crude steel is shaped into marketable shapes and sizes in the rolling mill. Big modern mills integrated with a BF/BOF unit, and using its output in molten form /continuous casting/, are matched in size to the BF/BOF shops, and may accordingly produce up to 10 million tpy and more of rolled products, including the technologically more difficult shapes like wide heavy plate. For most developing countries, mini and midi mills making long products /"merchant bars"/, having outputs as low as 20 000 tpy, may make good economic sense. At the low end of the range, a mini mill is usually entirely scrap-fed by an electric furnace, being too small as it is to be integrated with a BF or DR unit. It also will probably not produce an flats" /sheet, plate, coil/: the investment into a flats mill is too big to be paid for by an output rate as small as this. Also, flats rolling is a more demanding operation. A flats shop may be justified above a total mill output of 100 000 t.

Such a unit /a midi mill/ can usefully be integrated with a DR/EF steel plant or a BF/EF one if the BF unit is charcoal-fed.

Leaving aside the forestry required for charcoal iron making /which confines the viability of the operation to regions with a warm to hot climate, abundant rainfall and good soil/, the above outline permits to identify the mineral resource needs of ferrous metallurgy as iron ore, coking coal or some other reductant and possibly electric power. We shall not consider the alloying elements here because that would take up too much space; in any case, as long as international or at least interregional trade functions tolerably, there is no heavy argument against importing those.+

As a memorandum item, let us recall that steel mills, and iron making units even more, are great consumers of water. A minimum of about 30 m^3 is required per ton of steel, but 100 m^3 is better and 250 m^3 is best. This is another environmental limitation on ferrous metallurgy.

As another memorandum item, scrap may be a problem in some developing countries. In many least developed countries, where even old tins may be cherished possessions /the "bidonville syndrome"/, ferrous scrap generation may be very scanty. Also, scrap collection and sorting is a fairly sophisticated operation. In Angola, enough scrap to feed a 30 000 tpy minimill used to be collected pre-Independence; with all the Portuguese scrap merchants gone, the country has solicited UNIDO assistance for rebuilding the scrap system.

+Reserves, resources and production rates are presented in an Appendix.

F.1.2 The resource base

F.1.2.1 Iron ore

World iron ore reserves are immense, sufficient for more than a millennium at 1985 forecast consumption levels. Japan is the only UNITAD region strapped for ore /Table 22/ Regionally speaking, no developing region has an iron ore reserve problem. Intra-regionally, of course, there are many developing countries which have no iron ore deposits viable on even the smallest industrial scale /although I do not think there is any country on earth that has no iron ore usable in the artisanal, backyard-furnace mode/. Also, much of the ore in the table is not of direct-reduction grade: in fact, DR grade ore tends to occur in the biggest, best deposits.

World iron ore production /Table 23/ is also fairly balanced. The UN Statistical Yearbook lists 54 iron ore producing count-

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World bituminous coal and anthracite reserves - recoverable

Table 21

Region	Reserves 10^6 t	Reserves %
1 NA	108 790	22.28
2 WE	70 773	14.49
3 EE	134 005	27.45
4 JP	1 050	0.22
5 OD	50 725	10.39
6 LA	2 560	0.52
7 TA	7 130	1.46
8 NE	299	0.06
9 IN	13 320	2.73
10 AS	131	0.03
11 OA	99 450	20.37
Totals	488 233	100.00

Source: UN World Energy Statistics, 1979

Table 22

World iron ore reserves and resources

Resources inclusive of reserves

Region	Reserves 10^9 tons[+]	Reserves %	Resources 10^9 tons[+]	Resources %
1 NA	145	15.6	441	22.4
2 WE	69	7.4	106	5.4
3 EE	281	30.2	517	26.3
4 JP	-	-	-	-
5 OD	120	12.9	218	11.1
6 LA	192	20.6	468	23.8
7 TA } 8 NE }	22	2.4	45	2.3
9 IN	56	6.0	79	4.0
10 AS	18	1.9	27	1.4
11 OA	27	2.9	64	3.3
Totals	930	100.0	1965	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

[+] Contained iron

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ries, only 26 of which are developing. There are thus about 80 developing countries anyway with no significant industrial-scale iron ore production.

Table 24 presents the adequacy or otherwise of the regions' iron ore production in terms of their pig iron production. Japan and WE emerge as the two regions heavily dependent on iron ore imports. The North American deficit could be balanced at small additional outlay. The only developing region to grow a deficit by 1995 is AS + IN. It should, however, be pointed out that, in a de-

Table 23

World iron ore production, 1978, and capacity, 1978 and 1985

contained iron

Region	Production in 1978 million tons	%	Capacity 1978 million tons	%	Capacity 1985 million tons	%
1 NA	78.9	16.4	117.0	17.4	112.5	16.0
2 WE	39.6	8.2	64.9	9.7	64.6	9.2
3 EE	131.9	27.4	154.8	23.0	163.3	23.2
4 JP	-	-	-	-	-	-
5 OD	70.1	14.6	99.3	14.8	105.7	15.0
6 LA	77.2	16.0	129.0	19.2	142.9	20.3
7 TA 8 NE	20.5	4.3	28.3	4.2	30.1	4.3
9 IN	23.8	4.9	34.5	5.1	37.2	5.3
10 AS	8.0	1.7	10.9	1.6	10.9	1.5
11 OA	31.5	6.5	33.6	5.0	36.3	5.2
Totals	481.5	100.0	672.3	100.0	703.5	100.0

Source: Mineral Facts and Problems, op. cit.

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linked world, WE could, albeit at considerable cost, produce its own iron ore, and, supposing there is no E-W de-linking, could purchase its needs from EE as a better alternative. It would be no problem to produce AS + IN's iron ore needs within the region. The only unit not even remotely capable of self-sufficiency is Japan; it, however, can and does rely on Australian ore.

In the de-linking scenario, the South would have a substantial excess iron ore producing capacity overall, or, on the reverse side of the coin, a substantial pig iron shortage.

Table 24

Iron ore production /Fe content/ minus pig iron production

million tons per year

Region		1963-5	1966-8	1972-5	1976-8	1985	1990	1995
1	NA	- 13.4	- 12.2	- 12.5	- 10.9	- 8.6	- 13.0	- 12.0
2	WE	- 31.8	- 40.8	- 64.1	- 65.2	- 83.7	- 95.0	-107.5
3	EE	1.8	0.3	- 1.8	- 6.0	- 0.3	8.9	9.5
4	JP	- 23.7	- 39.5	- 85.3	- 83.5	-106.0	-117.3	-127.8
5	OD	0.9	8.4	48.7	60.6	90.2	114.4	142.5
6	LA	28.6	34.6	57.6	64.4	68.3	73.2	82.5
7-8	TA+NE	16.4	24.7	38.1	24.8	37.6	47.0	54.0
9-10	AS+IN	14.3	17.1	18.6	14.7	0.3	- 6.1	- 23.2
11	OA	2.4	1.8	0.1	1.3	3.5	2.3	8.0
World misfit+		- 4.4	- 5.7	- 0.5	0.3	1.3	14.5	26.0

+ World total iron ore production minus world total pig iron production

Source: Author's calculation based on various sources

F.1.2.2 Coking coal

For want of a suitable coking coal reserve statistic, we shall, for better or for worse, assume coking coal reserves to be distributed just as the reserves of bituminous coal and anthracite, Table21. This distribution is very uneven and very heavily biased against the developing country groups. Further exploration may improve the situation in Latin America, in Southern Africa, and possibly in India and Asia, with the NE unit being least hopeful.

Moreover, while the bituminous coal market has been a buyers' market practically all the time since the Korean War, coking coal and coke are not abundant and fetch much better prices. In fact, about 80 % of the 250 million tons or so of coal moving in international trade is coking grade.+

+ Coke consumption per ton of pig can be reduced by introducing other fuels /gas, fuel oil etc./, if cheaply /domestically/ available. Coking coal consumption can be reduced by using formed coke /non-coking coal in a coking-coal matrix/, a recent innovation.

This would, in a delinking scenario, probably be the major resourcewise bottleneck of the developing world's steel development on any larger scale. It could be helped only by setting up a long-distance sea trade with China and possibly India as the main sources. It would also push developing countries towards direct-reduction ironmaking. For that reason, the tables on natural gas and petroleum reserves should also be studied. /Tables 6 and 2/.

F.1.2.3 Electric power

Developing countries that, on the strength of their developable/developed hydro power resources could go in for electric steelmaking /and aluminium electrolysis/ include

- in LA: Argentina, Brazil, Chile, Colombia, Costa Rica, Guatemala, Venezuela, El Salvador;
- in TA: Angola, Ethiopia, Malawi, Mozambique, Nigeria, Sudan, Zambia and the Ivory Coast;
- in NE: Egypt;
- in IN: India;
- in AS: Indonesia, the Korean Republic, Malaysia, Papua New Guinea, the Philippines, and Thailand.

In addition, a large quantity of natural gas-based electricity could be generated in the NE group.

F.1.3 Technology and siting pattern

The two variables of the technology pattern are distance from tidewater /which here boils down to whether a country is land-locked or not/ and the size of the economy in GDP terms. At the small-size end of the land-locked group /up to, very roughly, an annual GDP of $1.5 bn[+]: Laos, Mali, Centrafrican Republic, to

[+] As stated in 1980 dollars in the IBRD's World Development Report for 1982.

name just a few/ the country will probably prefer to set up one or two efficient all-purpose /iron, steel and nonferrous/ foundries, in connection with the railways if it has any, also a number of simple but non-artisanal forges to make agricultural implements etc. At the bottom of the range, however, even such units may be non-profitable, utility-type facilities. Regionalisation, even subregionalisation, unjustified.

It is roughly at the $2 to $2.5 billion level that it starts to be justified to think of a rolling mill for long products, using imported ingot eked out with scrap, or vice versa. If all goes well and demand picks up, a DR/EF or a BF(charcoal)/EF unit may be added upstream, if the inputs are available. These considerations hold whether or not the country is land-locked. There is an obvious potential here for subregionalisation /say, groups of two-three countries in the ECOWAS union/, especially if none of the countries has all the necessary inputs on its own. In big countries /like Nigeria e.g./ it is justified to set up several such centres in the country, possibly fed out of a large central BF works.

The smallest-size economy to my knowledge that has a fully integrated one million tpy steelworks, partly BF/BOF and partly BF/open-hearth, is Zambia /$3.6 bn/, owing no doubt to its unique situation as an ex-white-settler economy. The concept seems somewhat obsolete, however. Today, the smallest-size economy building a major greenfield works /one million tpy/ is Pakistan /$21.4 bn/. Trinidad and Tobago /$5.3 bn/ and Paraguay /$4.5 bn/, on the other hand, are building mini-mills, of 0.5 and 0.12 million tpy output, respectively. All greenfield mini and midi plants a-building today are scrap/EF or DR/EF, except the Paraguayan one /which is BF/BOF, presumably charcoal-fed/.

Of the major greenfield plants currently being built or designed, only one /sited in Canada/ is in a developed country. The 13 others are in NICs or NICs-to-be /Brazil, Mexico, South Korea, Taiwan, India, Pakistan, Iran, Indonesia, the Philippines, Algeria, Libya, Nigeria. Their total initial capacity is to be 28.5 million tpy in crude steel terms, 9.0 mtpy of it by the DR/EF route.

This fact and the figures in Table 26 reveal that the top end of the developing country group meshes nicely with the developed group. The developing-country steelmakers in the top 50 of the world may by 1990 produce about 10 % of both world pig iron and world crude steel. They will be eager to find markets in the developing countries; their works sited on tidewater will export rolled steel, whereas the inland works of major economies like Bhilai and Bokaro in India will supply engineering industries aggressive in marketing. These industries will be eager to export steelworks equipment also, as secondary technology sources on the way to becoming primary ones. Mexico's proprietary HyL direct reduction process is a pointer in that direction.

Table 25

Steel production minus steel demand
million tons per year

Region	1963-5	1966-8	1972-5	1976-8	1985	1990	1995
1 NA	- 4.9	- 15.1	- 14.6	- 17.6	- 16.7	- 14.2	- 16.5
2 WE	10.2	13.6	18.9	19.5	19.8	19.1	19.0
3 EE	0.9	2.4	- 1.3	- 5.0	- 0.4	2.3	1.5
4 JP	9.6	12.2	34.9	42.2	45.1	41.1	43.0
5 OD	- 0.8	0	- 0.3	3.9	6.3	8.8	10.2
6 LA	- 3.8	- 3.9	- 9.3	- 7.8	1.6	6.7	9.0
7-8 TA+NE	- 4.9	- 6.3	- 13.6	- 20.3	- 27.1	- 33.0	- 41.2
9-10 AS+IN	- 5.5	- 4.9	- 10.4	- 11.6	- 17.6	- 17.5	- 12.7
11 OA	- 0.3	- 2.1	- 3.5	- 3.7	- 10.1	- 11.9	- 11.8
World misfit+	0.5	- 4.1	0.8	- 0.4	0.9	1.4	0.5

+ World total steel production minus world total steel demand

Source: Author's calculation based on a variety of sources.

Table 26

Developing-country steel producers among the world's top fifty or likely to join that group by 1985

Name	Country	World rank	Capacity, million tons per year							
			BOF 1977	BOF 1985	OH 1977	OH 1985	EF 1977	EF 1985	Pig 1977	Pig 1985
Usiminas	Brazil	43	3.00	3.50	-	-	-	-	3.40	3.40
Pohang	S Korea	46	2.60	9.60	-	-	-	-	2.37	8.00
Somisa	Argentina	47	1.40	1.40	1.10	1.10	-	-	2.08	3.34
Bhilai	India	48	-	1.30	2.50	2.50	-	-	2.97	3.97
Zenica	Yugoslavia	49	1.30	1.75	1.10	1.10	0.03	0.15	1.90	1.90
Sidor	Venezuela	50	-	-	1.20	1.20	1.20	3.60	0.92	0.92
Cosipa	Brazil		2.30	3.50	-	-	-	-	2.27	2.84
CSN	Brazil		0.80	3.00	1.00	1.00	-	-	3.50	4.32
Bokaro	India		1.70	4.00	-	-	-	-	2.70	3.72
Sicartsa	Mexico		1.25	1.25	-	-	-	2.00	1.10	1.10
China Steel	Taiwan		-		-	-	-	-	1.50	2.80
Total			14.35	29.30	6.90	6.90	1.23	5.75	24.71	36.31
% of world total			3.4	6.4	9.2	20.6	0.9	3.1	5.1	7.5

Source: Peter F, Marcus and Karlis M. Kirsis, World Steel Dynamics, Core Report R, Paine Webber Mitchell Hutchins Inc., June, 1982.

F.1.4 Scope for expansion

That scope is best characterised in terms of the following figures.

Table 27

Intra-South steel trade in 1976, million dollars

SITC group	Item	Southern imports from World	Southern imports from South	of which inter-regional	of which regional	of which subregional
673.2	Steel longs	1386.0	166.0	124.6	17.9	23.5
674	flats	3514.0	98.5	11.4	32.6	54.5
677.0	wire	360.0	31.7	16.9	8.5	6.3
678	tubes, pipe	3125.0	237.6	68.0	117.5	52.6
691.1	Iron, steel structs.	1365.0	102.8	32.6	32.6	12.5

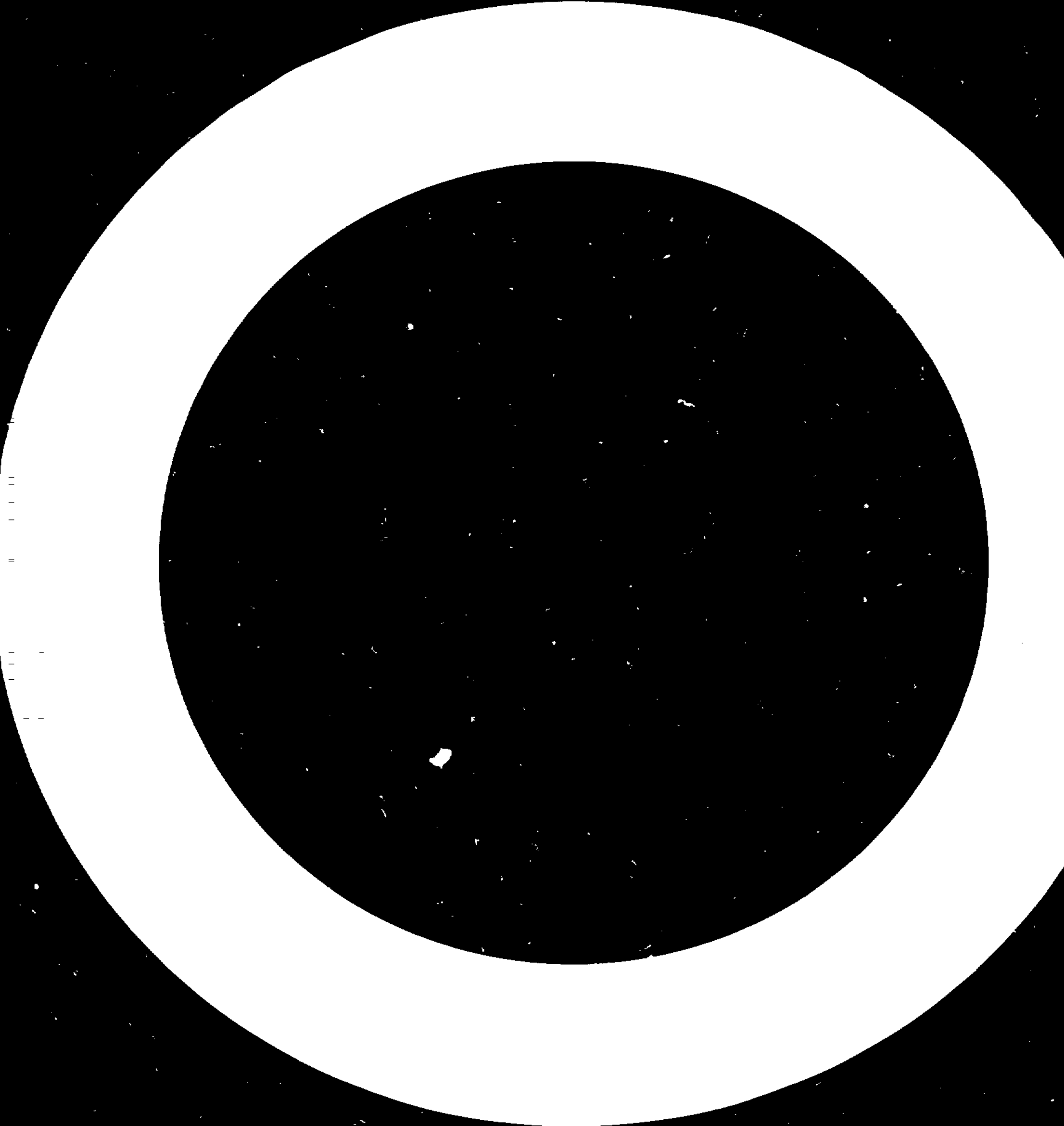
Source: TD/B/C,7/36/Add.3, op. cit.
Remark: Rumania, Turkey and Yugoslavia figure as developing countries.

The Southern share of flats, 2.8 %, is an outstandingly low value among all the items listed in the source.

By and large, most of the imports of longs could be substituted by domestic or subregional construction of strategically sized mini or midi mills. Flats would need more of a regional or interregional approach.

F.1.5 Other issues of South-South cooperation

Once again, as far as this writer is aware, South-South cooperation in iron and steel going beyond simple trade is conspicuous by its absence. A project under UNIDO auspices to join together the iron and steel development projects of Angola and Mozambique is all the more to be welcomed.



F.2 - Non-ferrous metallurgy

F.2.1 Aluminium

The aluminium industry's technology pattern is comparatively simple. Practically the only raw material used is bauxite. It is converted into alumina /aluminium oxide/ in a stage of hydrometallurgical beneficiation; alumina is converted to the metal in a process of igneous electrolysis /smelting/ which is a great consumer of electricity /typically, 15 000 to 17 000 kWh per ton of metal all told/. Up to the 1960s, electric power used to be considered cheap enough for aluminium smelting at 3 US mills per kWh; nowadays 3 US cents is considered on the favourable side. This made /and still makes/ it obvious to site smelters where cheap power /hydro power by preference/ is available, although today gas-based electricity in the big gas-producing and gas-flaring countries is a viable possibility. The alumina plant is sited either next to the smelter or next to the bauxite mine; there is no clear-cut transportation advantage either way, but the insistence of the bauxite-producing countries on a higher degree of processing has been shifting the balance in favour of the second option.

F.2.1.1 The reserve position

Tropical Africa and Latin America are the two richest regions: they possess more than 60 % of the world reserve between them. In the North, Australia is rich enough to satisfy all Northern needs at a pinch.

As far as smelting is concerned, cheap unused sources of electricity are confined to the developing world nowadays. Both hydro-power and otherwise unused natural gas may be suitable sources. For a list of developing countries that might go in for electrolysis, consult p. 61.

Table 28

World bauxite reserves and resources, 1979, dry weight and recoverable aluminium content

Resources inclusive of reserves

Region	Reserves dry weight million tons	%	Reserves recoverable aluminium content million tons	%	Resources recoverable aluminium content million tons	%
1 NA	40	0.2	9.1	0.2	45.3	0.6
2 WE	1145	5.0	231.3	4.9	412.8	5.1
3 EE	645	2.8	127.0	2.7	258.5	3.2
4 JP	-	-	-	-	-	-
5 OD	4520	19.9	911.7	19.3	1437.8	17.9
6 LA	6200	27.3	1369.8	29.0	2268.0	28.2
7 TA	8205	36.2	1687.4	35.8	2603.6	32.4
8 NE	-	-	-	-	-	-
9 IN	1000	4.4	204.1	4.3	408.2	5.1
10 AS	765	3.4	149.7	3.2	403.7	5.0
11 OA	150	0.7	27.2	0.6	190.5	2.4
Total	22670	100.0	4717.3	100.0	8028.4	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

F.2.1.2 Siting and technology

Economies of scale in the aluminium smelter, and even more in the alumina plant and the bauxite mine, are considerable. Alumina plants today are in the 0.5 to 2.4 million tpy range; smelters in the 100 000 to 500 000 tpy range. There is no mini alumina plant or smelter in sight. Even within a very large regional economic association, facilities must be at least partially export-orientated if they are to profit fully by the economies of scale possible. In any case /cf. Table 29/, the South's smelter capacity,

Table 29

World bauxite, alumina and aluminium production estimated and capacity, both 1978

million tons of aluminium or aluminium equivalent

Region	Bauxite product. 10^6 t	%	Bauxite capacit. 10^6 t	%	Alumina product. 10^6 t	%	Alumina capacit. 10^6 t	%	Aluminium product. 10^6 t	%	Aluminium capacit. 10^6 t	%
1 NA	0.4	2.1	0.5	2.5	3.6	23.7	4.4	23.2	5.4	38.4	5.8	33.8
2 WE	1.5	8.7	2.1	9.6	2.5	16.1	3.5	18.3	3.7	26.6	4.2	24.3
3 EE+	1.5	8.7	1.9	8.5	1.9	12.1	2.3	12.0	1.9	13.8	3.0	17.8
4 JP	-	-	-	-	0.8	5.1	1.3	7.2	1.1	7.5	1.6	9.6
5 OD	4.9	28.6	6.1	27.6	3.5	22.9	3.6	19.3	0.4	2.9	0.4	2.3
6 LA	4.7	27.6	6.9	31.4	2.1	13.9	2.6	13.6	0.4	2.9	0.7	3.9
7 TA	3.1	18.2	3.3	14.9	0.3	2.1	0.4	1.9	0.3	2.4	0.4	2.6
8 NE	-	-	-	-	-	-	-	-	0.1	0.7	0.1	0.6
9 IN	0.3	2.0	0.4	1.6	0.3	1.7	0.3	1.9	0.2	1.5	0.4	2.1
10 AS 11 OA	0.7	4.2	0.9	3.9	0.4	2.5	0.5	2.6	0.5	3.2	0.5	3.0
Totals	17.1	100.0	22.1	100.0	15.4	100.0	18.9	100.0	14.0	100.0	17.1	100.0

+ The nepheline syenite and alunite mined in the USSR are excluded

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

small as it is, can almost satisfy its aluminium metal demand, which is comparably small /in fact, with OA disregarded, the South has a surplus/. The problem is that most of the metal consumed in the South comes from Northern smelters, whereas metal from the Southern smelters is taken North. In 1976, only 23 % of the aluminium semis imported by the South came from Southern sources+, 5.7 % in interregional, 11.9 % in regional and 5.6 % in subregional trade. Corresponding figures for aluminium structures

+ TD/B/C.7/36/Add.3, op. cit.

Table 30

Regional gaps between the production and consumption of five non-ferrous metals, 1979

Negative signs indicate consumption uncovered by production

Region	Aluminium	Copper	Lead	Zinc	Tin
	t h o	u s	a n d	t	o n s
1 NA	62.8	-644.3	15.4	- 89.9	- 49.8
2 WE	-281.7	-886.8	- 80.2	134.7	- 35.9
3 EF	95.6	-371.8	- 66.9	99.7	- 22.7
4 JP	-791.6	-130.0	- 45.9	56.9	- 28.3
5 OD	232.0	72.3	197.6	206.5	0.9
6 LA	103.4	256.5	174.2	25.3	13.3
7 TA	218.8	298.0	- 15.7	81.9	0.9
8 NE	- 62.8	- 2.0	43.8	- 17.5	1.4
9 IN	- 12.2	6.7	- 37.8	- 44.4	- 2.6
10 AS	-144.2	- 29.0	- 77.6	-206.7	111.7
11 OA	-220.0	-105.0	- 40.0	- 25.0	4.0
/1/	-799.9	-1535.3	66.8	221.5	- 1.1
/2/	-117.7	425.2	46.9	-186.4	137.4

Remarks. /1/ is the difference between world total production and world total consumption. It piles up in inventories, bonded warehouses etc., or flows out of those.
/2/ is the South's net position.

Source: Author's calculations based on Metallgesellschaft Aktiengesellschaft, Metal Statistics 1969-1979, 67th Edition, Frankfurt am Main, 1980.

are 20.8 %, 10.4, 5.7, and 4.7 %, respectively. For example, India in 1980-81 imported some 130 000 t of aluminium compared with a domestic production of 200 000 t. This is made possible by the fact that, as opposed to alumina plants and smelters, semi-fabricating and fabricating plants may be very small, even less than 10 000 tpy.

F.2.1.3 Scope for South-South cooperation

/a/ Trade

Short-circuiting the trade flows that today pass through the North is an entirely viable opportunity. It would boost South-South trade by about 100 000 tons per year of semis and somewhat more metal.

/b/ Siting and expansion

Interregional cooperation on the pattern of the UNIDO-assisted project by which India is to finance a smelter in Mozambique and supply it with Indian alumina, and to buy back a major share of the metal produced, can be viable and should be explored.

/c/ Technology

Cf. the chapter on ferrous metallurgy.

F.2.2 Copper, lead and zinc

These metals are lumped together because of a common siting feature. Ever since the 19th century it has been usual to combine their mining and smelting on the same site. Accordingly, whereas only 12.2 % of aluminium smelting capacity is in the South /Table 29/, 47 % of copper smelting capacity is /Table 32/. For lead /22 %/ and zinc /14 %/, the situation is less clear-cut, but the bulk of these two metals is being mined in the North.

Table 31

World copper reserves and resources+, contained copper
Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	124	25.1	523	32.1
2 WE+NE	22	4.5	58	3.6
3 EE+OA	60	12.1	232	14.3
4 LA	169	34.2	468	28.8
5 AF	69	14.0	178	10.9
6 AS	27	5.5	91	5.6
7 OC	23	4.7	77	4.7
Totals	494	100.0	1627	100.0

+ The regionalisation of this statistic, used for reasons of consistency, could not be reconciled with that of UNITAD. AF means all Africa; OC means all Oceania. AS contains IN+JP.

Source: Mineral Facts and Problems, op. cit.

There is, however, a refining stage added to smelting in the case of these three metals. Although some refining does take place next to the smelters, a fair amount of smelted /unrefined/ metal enters international trade in a South-North direction /and so do smaller amounts of ore concentrate too/. The stage with the greatest value added, semi-fabrication, is predominantly Northern, although recently countries like Chile have been building and expanding semis capacities. With the tariff barriers against semis much higher than against metal, some of these capacities are joint ventures in a Northern country. Zambia and Chile have embarked upon such joint ventures in Western Europe.

World copper mine, smelter and refinery production and capacity,+ 1978

Region	Mine				Smelter				Refinery			
	production		capacity		production		capacity		production		capacity	
	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%
1 NA	2005	26.6	2760	29.6	1768	22.2	2510	25.3	2315	26.8	3250	28.9
2 WE+NE	157	2.1	220	2.4	579	7.3	620	6.2	1286	14.9	1670	14.8
3 EE+OA	1601	21.3	1810	19.4	1774	22.3	1910	19.2	1832	21.2	2400	21.3
4 LA	1491	19.8	1640	17.6	1341	16.8	1510	15.2	1052	12.2	1100	9.8
5 AF	1368	18.2	1710	18.3	1310	16.4	1730	17.4	909	10.5	1220	10.8
6 AS	486	6.5	770	8.2	1030	12.9	1420	14.3	1073	12.4	1410	12.5
7 OC	418	5.6	430	4.6	169	2.1	230	2.3	175	2.0	210	1.9
Totals	7526	100.0	9340	100.0	7971	100.0	9930	100.0	8642	100.0	11260	100.0

+ For footnote cf. preceding table.

Source: Mineral Facts and Problems, op. cit.

Table 32

Table 3

World lead reserves and resources, contained lead
Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	32	25.2	84	29.2
2 WE	18	14.2	35	12.2
3 EE	21	16.5	44	15.2
4 JP	-	-	-	-
5 OD	23	18.1	44	15.2
6 LA	20	15.7	48	16.7
7 TA	2	1.6	8	2.8
8 NE	4	3.1	10	3.5
9 IN 10 AS	4	3.1	8	2.8
11 OA	3	2.4	7	2.4
Totals	127	100.0	288	100.0

Source: Mineral Facts and Problems, op. cit.

F.2.2.1 The resource base

Copper. The Americas are outstandingly rich; apart from that, the distribution is fairly even. This in itself makes the viability of a CIPEC operating as a cartel questionable: to work, it would need substantial Northern backing /Australia? Canada?/.

Lead; zinc. The two metals are most often mined together. For both, Northern reserves are predominant, but Latin America has enough to satisfy the South's modest needs at a pinch.

Table 34

World lead mine, smelter and refinery production and capacity, 1978

Region	Mine production 10^3 t	Mine production %	Mine capacity 10^3 t	Mine capacity %	Smelter production 10^3 t	Smelter production %	Smelter capacity 10^3 t	Smelter capacity %	Refinery production 10^3 t	Refinery production %	Refinery capacity 10^3 t	Refinery capacity %
1 NA	850	24.7	965	23.5	759	22.2	931	19.6	759	22.7	931	19.9
2 WE	515	14.9	615	15.0	801	23.4	1228	25.9	866	25.9	1268	26.9
3 EE	701	20.3	725	17.7	703	20.6	810	17.1	703	21.0	925	19.7
4 JP	57	1.7	75	1.8	186	5.4	319	6.7	186	5.6	319	6.8
5 OD	400	11.6	450	11.0	356	10.4	410	8.6	204	6.1	230	4.9
6 LA	449	13.0	566	13.8	320	9.4	512	10.8	313	9.4	543	11.5
7 TA	66	1.9	175	4.3	67	2.0	135	2.8	67	2.0	135	2.9
8 NE	100	2.9	130	3.2	27	0.8	35	0.7	27	0.8	35	0.7
9 IN 10. AS	82	2.4	135	3.3	25	0.7	63	1.3	45	1.3	63	1.3
11 OA	225	6.5	270	6.6	174	5.1	302	6.4	174	5.2	275	5.5
Totals	3445	100.0	4106	100.0	3418	100.0	4745	100.0	3344	100.0	4706	100.0

Source: Mineral Facts and Problems, op. cit.

Table 35

World zinc reserves and resources, contained zinc

Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	45	27.8	128	39.4
2 WE	20	12.3	30	9.2
3 EE	20	12.3	36	11.1
4 JP	5	3.1	7	2.2
5 OD	27	16.7	59	18.2
6 LA	22	13.6	32	9.8
7 TA	4	2.5	6	1.8
8 NE	5	3.1	6	1.8
9 IN	3	1.9	4	1.2
10 AS	6	3.7	10	3.1
11 OA	5	3.1	7	2.2
Totals	162	100.0	325	100.0

Source: Mineral Facts and Problems, op. cit.

F.2.2.2 Siting and expansion

Of the 6 mn tpy of copper refining capacity to be built between 1975 and 1990, 1.15 mn is forecast to be in LA, 1 mn in TA+NE, and the rest in the North; capacity additions in the Asiatic sphere are not expected to be significant.

Of the 4 mn tpy of slab zinc refining capacity to be built between 1975 and 1990, just about 0.8 mn is expected to be in the South as a whole.

Of the 3 mn tpy or so of lead refining capacity to be built in the world between 1975 and 1990, a mere 0.6 mn is expected to be in the South as a whole.

Table 36

World zinc mine and primary metal production, 1978

Region		M i n e				P r i m a r y m e t a l			
		production		capacity		production		capacity	
		10^3 t	%	10^3 t	%	10^3 t	%	10^3 t	%
1	NA	1370	23.3	2050	25.8	902	16.1	1360	17.7
2	WE	1066	18.1	1475	18.6	1495	26.6	2242	29.1
3	EE	1064	18.1	1135	14.3	1251	22.3	1630	21.2
4	JP	275	4.7	345	4.3	768	13.7	1010	13.1
5	OD	545	9.3	755	9.5	369	6.6	414	5.4
6	LA	906	15.4	1150	14.5	322	5.7	394	5.1
7	TA	150	2.6	260	3.3	86	1.5	123	1.6
8	NE	30	0.5	60	0.8	126	2.2	140	1.8
9	IN	100	1.7	150	1.9	117	2.1	130	1.7
10	AS	252	4.3	425	5.4	59	1.1	81	1.1
11	OA	120	2.0	130	1.7	120	2.1	175	2.3
Totals		5878	100.0	7935	100.0	5615	100.0	7699	100.0

Source: Mineral Facts and Problems. op. cit.

This pattern is explained by the fact that new investment, just like the old facilities, is attached to the biggest and most viable ore deposits: it therefore reflects, by and large, the reserve distribution. There is, however, no denying the fact that, in recent times, miners of these ores tended to withdraw into the North. Southern cooperation in prospecting for viable deposits of these ores, possibly with DTCD or UNRFNRE backing, and possibly in the ongoing projects of development, is therefore recommended.

F.2.2.3 Trade

The reader is referred once more to Table 30. The net position of the South is seen to be negative in zinc, a small positive amount in lead, and a large one in copper. There is a considerable scope for short-circuiting trade flows passing through the North in copper, whereas in lead and zinc the effort seems to be unrewarding.

F.2.3 Tin

In comparison with the other metals, tin is a small commodity. What makes it remarkable is a number of politico-economic features. Admittedly, these would probably be unfeasible if the commodity were a more important one. One of these is the operation of the International Tin Agreement, of which more is to be said later. Another one is the takeover of the Southeast Asian deposits by the countries that own them and the successful development of a tin smelting industry which, by the method of input starvation, led to the quasi-total phase-out of Southeast Asian tin being smelted in Britain or any other Northern country.

F.2.3.1 The reserve situation

This is another biased distribution, much like that of petroleum or rock phosphate. The principal concentration is in Asia. The North is not self-sufficient. It should be added that the life of what are considered viable reserves today is running out: this is one of the reasons why tin prices have been rising faster than those of the other metals.

Table 37

World tin reserves and resources, thousand tons
Resources inclusive of reserves

Region	Reserves 000 t	Reserves %	Resources 000 t	Resources %
1 NA	70	0.7	440	1.2
2 WE	300	3.0	2230	6.1
3 EE	1000	10.1	2900	7.9
4 JP	-	-	-	-
5 OD	470	4.8	1210	3.3
6 LA	1400	14.2	6930	18.9
7 TA	590	6.0	3380	9.2
8 NE	-	-	-	-
9 IN	-	-	-	-
10 AS	4560	46.1	14100	38.4
11 OA	1500	15.2	5500	15.0
Totals	9890	100.0	36700	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

F.2.3.2 Siting and expansion

Much of what has been said in connection with copper, lead and zinc holds. The expected capacity addition between 1975 and 1990 is about 80 000 tpy for the smelter phase; it will be fairly evenly distributed, with Japan the only country in which a reduction in capacity is to take place. The greatest additions will be where the reserves are, in Southeast Asia, Latin America and Australia.

Table 38

World tin mine production, 1978, and capacity, 1978 and 1985, thousand tons

Region	Production in 1978		Capacity 1978		Capacity 1985+	
	000 t	%	000 t	%	000 t	%
1 NA	0.6	0.2	0.8	0.3	0.8	0.3
2 WE	4.1	1.6	6.6	2.4	7.3	2.4
3 EE	35.6	14.1	38.7	13.9	42.7	14.3
4 JP	0.6	0.2	0.9	0.3	1.0	0.3
5 OD	14.9	5.9	17.0	6.1	19.0	6.4
6 LA	40.2	16.0	44.1	15.9	48.6	16.3
7 TA	11.2	4.4	14.4	5.2	15.0	5.0
8 NE	-	-	-	-	-	-
9 IN	-	-	-	-	-	-
10 AS	122.5	48.7	130.0	46.8	134.0	44.9
11 OA	22.0	8.7	25.0	9.0	30.0	10.1
Totals	251.7	100.0	277.5	100.0	298.4	100.0

+ Author's estimate of the distribution of totals stated in the source.

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

F.2.3.3 Trade

Referring again to Table 30, the South is seen to be a net supplier practically everywhere, except for IN. In the North, OD, thanks to Australia, is the only region with a very slight surplus position. Significantly, about 80 % of the tin and tin alloys imported by the Southern countries comes from other Southern countries.+

+ TD/B/C.7/36/Add.3, op. cit.

Table 39

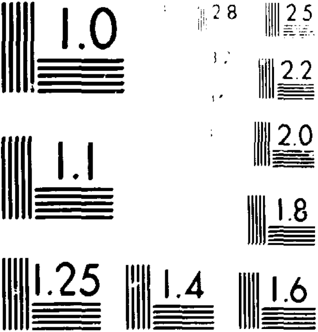
World tin smelter production, 1978, and capacity, 1978 and 1985, thousand tons

Region	Production in 1978		Capacity 1978		Capacity 1985+	
	000 t	%	000 t	%	000 t	%
1 NA	5.9	2.4	7.3	1.8	7.3	1.6
2 WE	21.3	8.6	50.7	12.7	52.7	11.9
3 EE	35.2	14.2	40.5	10.1	41.8	9.3
4 JP	1.1	0.4	3.5	0.9	2.0	0.5
5 OD	5.7	2.3	12.0	3.0	20.0	4.5
6 LA	24.5	9.9	37.5	9.4	53.5	12.1
7 TA	4.3	1.7	18.2	4.6	19.0	4.3
8 NE	-	-	-	-	-	-
9 IN	-	-	-	-	-	-
10 AS	127.2	51.5	194.8	48.8	208.0	46.9
11 OA	22.0	8.9	35.0	8.8	40.0	9.0
Totals	247.2	100.0	399.5	100.0	443.8	100.0

+ Author's estimate of the distribution of totals stated in the source

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding



MICROCOPY RESOLUTION TEST CHART

F.2.4 Other South-South cooperation in non-ferrous metals

Here, the two producers' associations, the International Bauxite Association /IBA/ and the copper producers' association /CIPEC/ come to mind first. Although not confined in membership to the South /Australia is a member of both/, they certainly were Southern initiatives. The principal preoccupation of these associations so far was to safeguard mineral prices, but they are the right sort of institutional background for future cooperation in metallurgy.

The International Tin Agreement /ITA/ is a producer-consumer body with a wide-ranging membership including the EE countries. It has been instrumental in unblocking tin prices and letting them rise in proportion to the growing scarcity of ore.

Cooperation in the fabrication of copper within Africa as exemplified by the negotiations now underway between Zambia and Nigeria on the one hand and Zambia and Egypt on the other, seems to be one of the best means of expanding the market potential of Southern copper in the South.

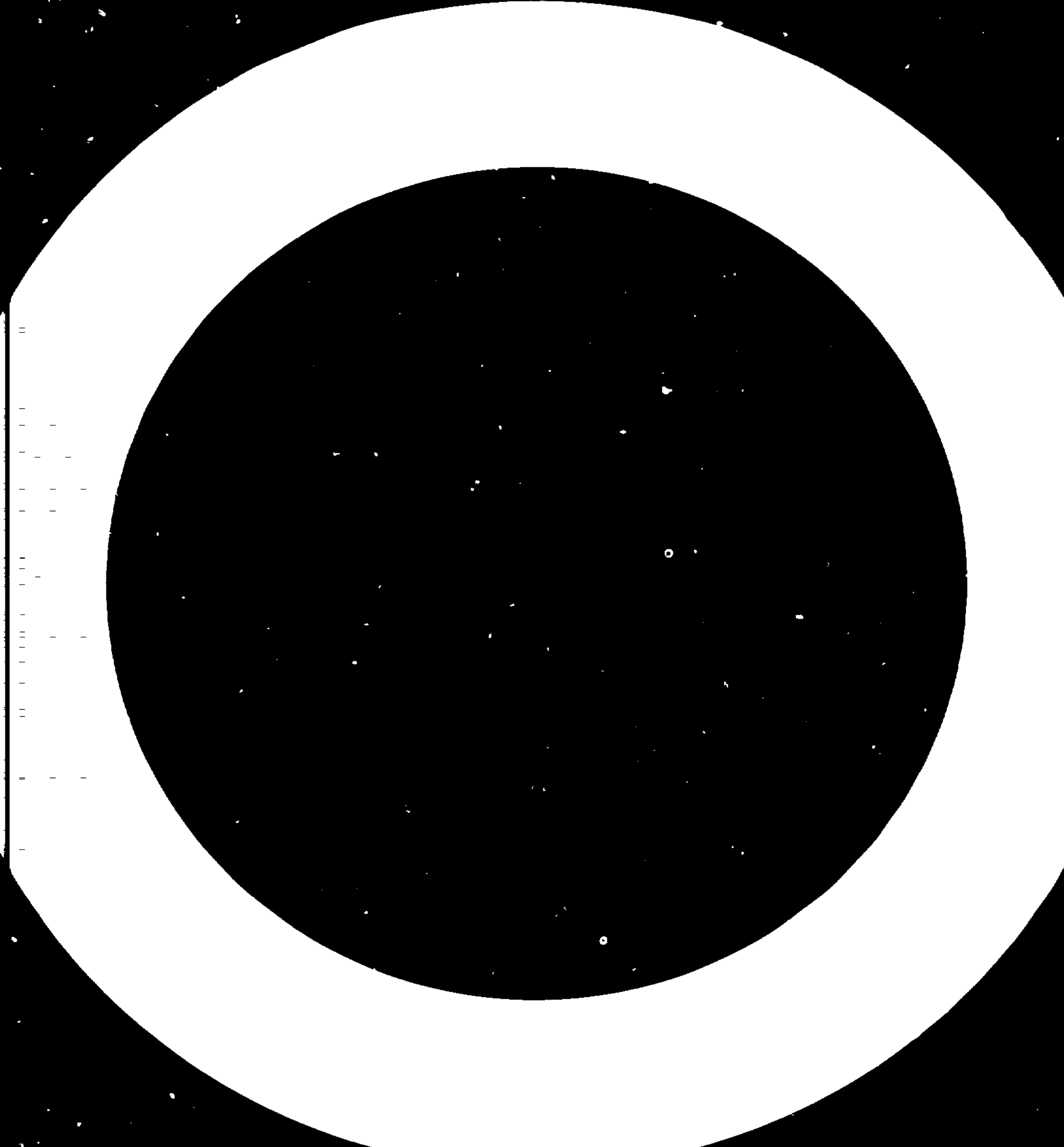
F.3 Availability of smelter technology in the South

"Metallurgical Plantmakers of the World" of the Metal Bulletin+ lists the number of metallurgical plantmakers in the South as

- 7 in Argentina,
- 29 in Brazil,
- 26 in India,
- 11 in the Rep. of Korea,
- 8 in Mexico,
- 2 in the Philippines,
- 1 in Singapore,
- 4 in Taiwan,
- 1 in Zimbabwe.

This reinforces the thesis that technology is available from the NICs. Many of these plantmakers have the sort of association with Northern companies which gives access to the most modern devel-

+ Second edition, 1981; ed. Richard Serjeantson opments in technology. Indian metallurgical plant is on offer in a broad range of Southern countries. Dastur GmbH is a branch in the FRG of a renowned Indian engineering company in metallurgy, a quasi-permanent consultant to UNIDO.



G Some general considerations

G.1 Tariff barriers

It has become something of a commonplace that tariffs of entry into the countries of the North for most mineral-based commodities increase, sometimes steeply, with the degree of processing of those. Perhaps the most striking case is zero percent on copper concentrates, 7 % on unwrought and 23 % on wrought copper in Japan, but the general situation is much the same for other metals in other countries.[+]

Similarly, in basic and more elaborate petrochemicals, a considerable tariff differential is observed to the detriment of the latter. Most basics are duty-free in most Northern countries, whereas intermediates carry a duty of about 10 % on average.[++]

The implication is that, as far as the comparatively modest markets of the South permit, a system of GSTP /Global System of Trade Preferences among Developing Countries/ may give a major boost to the setting up of facilities for the higher processing of minerals-based commodities in the South.

G.2 South-South trade

The first progress in South-South cooperation has been in trade. Between 1970 and 1979, the South's share increased from 19.6 % to 24.6 % in Southern exports and from 18.9 to 27.4 % in Southern imports. Trade splits about evenly between the interregional and the intraregional. One of the reasons for this growth was the development of a sizeable solvent market within the South, made up of the oil-exporting countries and to some extent between

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[+] For details cf. UNIDO, Mineral Processing in Developing Countries, ID/253, p. 100.

[++] For details cf. UNIDO, Second World-wide Study on the Petrochemical Industry, ID/WG.336/3/, op. cit.

the NICs; manufactures exports appeared and grew; technology transfer intra-South began, with India and Brazil as the main donors, etc. Trade was considerably promoted by the adoption of the Global System of Trade Preferences among Developing Countries. Trade structure also improved: the share of manufactures in South-South non-oil trade rose from 26.9 % in 1960 to 51.6 % in 1979; within it, the share of machinery, equipment and vehicles rose from 3.6 to to 17.5 %. All these trends are expected to continue; according to UNCTAD+, in 1990, more than 30 % of the South's SITC Group 3 exports and more than 50 % of its SITC Groups 5 to 8 exports are to be absorbed by the South.++

It is, however, imperative to have a realistic assessment of what South-South trade can and what it cannot do. Consider for example an African country importing copper semis from another African /or another Southern/ country. It cannot expect to be offered a price less than the ruling world market price, the price that it would pay to any other overseas supplier, Northern or Southern. There exists, however, the possibility intra-South to pay for such deliveries in goods which the buyer of the copper has and the seller wants. In this way, some hard-currency expenditure can be short-circuited, and the intra-South exchange of goods will reduce the overall hard-currency expenditure of the South. There is of course also an economy-of-scale advantage: larger plants working into more extensive markets can produce a unit of output more cheaply. Some freight costs may be saved; as shown above, mutual tariff advantages may be secured. In this respect, the experience of intra-CMEA trade is worth studying.

\+ Trade and Development Report, 1981, TD/B/863, July 31, 1981, p. 207.

++ For this section I have relied heavily on a paper by my colleague Dr Judit Kiss, A fejlődő országok egymás közötti együttműködése /Intra-developing country cooperation/, a manuscript, World Economy Institute, Hungarian Academy of Sciences, Budapest, November 1981.

A question to be asked with great insistence, however, is in what way should the benefits be split.

For one thing, dismantling tariff barriers is no positive-sum game. CEAO /Commission Economique de l'Afrique Occidentale/ has, for example, raised the issue that trade liberalisation involved loss of fiscal earnings as a major problem, resulting in a growing tendency to limit trade liberalisation and to exact compensation in other, non-tariff ways.+

For another thing, there is the issue of higher degrees of processing. Who in the South should do it? To consider the example of rock phosphate and phosphate fertiliser, the opportunity for the rock producers to set up new fertiliser capacity with the Southern markets in mind has been pointed out above. Much the same case can, on the other hand, be made out for the deficit countries/regions to import rock phosphate and set up their own phosphate fertiliser plants. In the final reckoning, some sorthof balance, depending on, among other things, the finance available for fertiliser plant investment, should be expected to emerge. But this issue will be just as controversial intra-South as it is in the South-North relation.

Thirdly, there is the issue of the quid pro quo. What can Southern countries offer in exchange for the goods bought from other Southern countries? The reply is that the richer countries of the South with their comparatively large-sized and developed economies will not have any difficulty in finding the right sort of complementarities. The poorest countries of the South, which among many other reasons are so poor precisely because their endowments interdict their more intensive integration into the world economy, will have much the same difficulties as they have today. Let us recall that much of the indebtedness of these countries is due to the high prices of crude and products, which is essentially an intra-South trade flow.

+ TD/B/C.7/55. 30 July 1982. p. 7.

G.2.1 Brazil: A Case Study [+]

The case of Brazil's trade with Africa is best presented in terms of the following figures.

Table 40

Brazilian foreign trade with Africa[□], million US dollars

	1966-69 average	1970	1975	1980
Total exports, FOB				
World	1897	2739	8670	20132
Africa, %	1.4	2.2	4.6	5.7
Manufactures exports				
World	...	416	2585	9028
Africa, %	...	4.5	6.6	8.3[+]
Total imports, CIF				
World	1890	2849	13592	22955
Africa, %	1.7	3.2	4.0	4.8
African surplus/deficit on total trade	7	32	144	-206

[+] 1979. [□] Includes South Africa.

In 1980, the countries of developing Africa which imported more than $100 million worth of goods were Algeria, Angola, Egypt, Nigeria, and Zaire. Nigeria led the pack with $272 million. The countries which exported more than $100 million worth to Brazil were Angola, Gabon and Libya, with Gabon at $301 million at the top. Remarkably enough, Brazil's African transactions, as far as mineral resources go, are a one-way street: Brazil imports phosphates from Morocco and copper from Zaire, and intends to purchase copper from Zambia, alumina from Guinea, and phosphates from Se-

[+] Cf. Tom Forrest, Brazil and Africa: Geopolitics, Trade, and Technology in the South Atlantic, African Affairs, January 1982 negal. The main item, though, was crude oil, which made up about 70 % of Brazilian purchases in Africa. On the other hand, such Brazilian direct investment and plant and equipment exports to Africa as there are seem to avoid mineral resource-based industries. The Brazilian CVRD /Companhia Vale do Rio Doce/ has set up a steel plant in Egypt. Petrobras, the Brazilian state oil company, has invested in Algeria and Libya, intends to cooperate with the Nigerian National Petroleum Corporation, has a share in an Angolan oil concession and has applied for a share in another. Brazil does sell iron and steel semis and refinery products to Nigeria, and a joint venture in aluminium products has been envisaged. Petrobras has further undertaken to assist the Angolan oil industry.+

Brazil has placed a great emphasis on technical assistance to the Portuguese-speaking countries of Africa, where the language gives Brazil a considerable advantage. Brazil is an enthusiastic supporter of the South-South cooperation concept: in 1980, it set up a fund for the promotion of TCDC activities. In 1979, UNIDO hired a Brazilian consultancy company to survey food processing plants in Angola.+

This concise case history permits to draw a number of relevant inferences.

- There is sufficient complementarity between the economy of Brazil and those of the African countries to have permitted trade turnover to grow by 25 % per year, 1970 to 1980, despite a considerable overlap of products /coffee, cocoa, iron ore, diamonds, etc./.
- The division of labour is basically of the developing-vs.-developed-country type, with manufactures making up about 80 % of Brazilian exports to Africa in 1979.
- There is a considerable scope for expansion: to focus on the subject of the present paper, Brazil could become one of the major sources of equipment for mineral resources-based investment in Africa, either under direct in-

vestment projects or as an arms-length supplier, either on its own or in a tripartite deal with a developed ME or CPE supplier. Brazil could absorb without any difficulty the minerals offered in payment which currently go to pay for similar supplies by developed market-economy suppliers.

G.3 Manpower

This is an issue that has been widely discussed both within and outside the UN family. We shall consider two aspects here: skills and international movements of labour.

/1/ Skills. All the industries described here are skill-intensive: they require practically no unskilled labour and few semi-skilled workers; on the other hand, they require comparatively many plant engineers and skilled technicians. Clearly, it will be the simpler to muster this labour force, the more developed the economy of a country and the bigger its size. Yet one may say that there is a shortage of manpower with these skills in practically every developing country, NICs included.

This in turn raises the issue of training. One of the promising experiences of South-South cooperation so far has been in the training of the nationals of one Southern country in another: Angolan oilmen in Algeria, fertiliser plant operators from Bangladesh in Indonesia, etc. The much-discussed pitfall is that people so trained "will not acquire Western attitudes to plant operation". The question as to whether this is a praise or a shortcoming has not so far been discussed adequately, and would require study, possibly by UNIDO.

/2/ Movements of labour. The only major-scale labour movement so far in the South has been from North Africa and South Asia into the Arab Gulf. In 1979, it generated expatriates' remittances to the tune of $10 bn. It involved both skilled and unskilled labour, and also numerous persons with business or managerial qualifications. While this might benefit the host country, it is no unmitigated boon to the country of origin: Egyptian steelmen complain that their maintenance personnel leaves them for the Gulf about as fast as they can train them. An intra-South brain drain?

G.4 Institutional framework

As we have seen, there exist two sets of institutional framework that may expand in step with the necessities of the times: /1/ country and regional fertiliser institutions and /2/ minerals producers' associations which, albeit not closely connected with our subject here, are exemplary in many fashions.

It follows that:

- regional and interregional cèntres should be set up as nuclei for associations in refining /including non-OPEC countries, or indeed especially those/, basic petrochemicals or petrochemicals at large, in ferrous and non-ferrous metallurgy,
- it is important to create an awareness of the need for such associations, and of the problematiques they are expected to tackle - a task of the UN Family, more particularly of UNIDO,
- the way the benefits of South-South cooperation are expected to arise and the way they are to be split is an issue in need of considerable study; it should involve these same associations, presumably likewise under UN sponsorship.

Finally, and most importantly, a dialogue should be initiated with the interested Northern associations in order to minimise the impact of South-South cooperation and the gradual delinking it would entail upon the North.

G.5 Technology

All the industries considered here are roughly of the same degree of technological sophistication; it is therefore indicated to survey them together from the technological point of view.

They are often hooked up direct to a mining facility and/or to portuary facilities. These are not to be considered here but it is useful to remember that siting and developing a mine and developing a haulage pattern between the mine and the processing facilities, siting those latter, adapting them to the markets available and optimising the entire system so constituted /which includes endowing it with sufficient flexibility to adapt to the foreseeable range of changes in its parameters/, a group of activities which we shall call systems consultancy here, is something for which developing countries are less equipped as a rule - this holds even for the most developed NICs - than for straightforward engineering design. Systems consultancy would, in any competitive situation, include the sort of project identification study and basic engineering which is called upon to optimise a project with keen world market competition in mind, and to select for it, from the full range available, the process or processes and the process parameters most apt to attain that end. As an obvious corollary, all these conditions can be relaxed if, and to the extent that, world market competitiveness becomes a secondary consideration or falls by the wayside altogether.

Anticipating, it should be pointed out that it is in systems consultancy that the South most needs the assistance of disinterested organisations like UNIDO.

Let us consider engineering. UNIDO's First Global Study on the Capital Goods Industry /:ID/WG.342/3:/ sets up a six-level ranking for capital goods, with hand tools at level 1 and twin-engined turbo-prop and jet aircraft at level 6. It states /p. 120/ capital goods for the chemical and petrochemical industry to be overlapping from level 3 to level 4 and those for heavy metallurgy to occupy level 4 /significantly, oil drilling equipment is placed at level 5/. It further points out that, in technological sophistication, two discontinuities are evident /p. 112/: one is roughly between levels 3 and 4, the other between levels 4 and 5. It takes a considerable effort to overstep either of these discontinuities.

In terms of the above complexity ranking, one may say with some confidence that there are about ten countries that can manufacture, with qualifications to be stated below, level-four equipment, that is, equipment for the industries considered here. These include India, Brazil, Argentina, Turkey, the Republic of Korea, Mexico, Egypt, Hong Kong and Singapore and, in the OA group, China.

Countries whose capital goods industries may be termed embryonic include Iran, Algeria, Venezuela, Indonesia, Colombia, Peru, Chile, Pakistan, Thailand, the Philippines, Malaysia, Iraq, Jamaica, Sri Lanka, Uruguay and Nigeria.

One major qualification is that even the most developed of these industries will probably not be able to design/produce/supply certain components which includes some of the instrumentation, most of telemetering, control and automation systems and equipment, catalysis and catalysts, high-performance process compressors, process pumps, turbines or at least rotors for the same.

Another major qualification is that, given their current capacities, these industries would certainly be incapable of satisfying all the needs of the South at once - coping even with a substantial percentage, let alone the totality, of those needs would require a fairly lengthy development.

At an estimate,

- the first group mentioned above would be able to provide detailed engineering designs for, and to produce, 90 to 95 % of the capital goods /machinery, equipment and processes/ for the industries considered here, except for probably the most recent and most sophisticated ones,

- the second group would be able to execute, and in part to design, the brick, concrete and metal construction and structural work required for the plants in question, to do, albeit perhaps not design except at the detailed working drawing level, most of the boilerwork /which makes up a high percentage of pr ,ess equipment in petroleum refining, petrochemicals, alumina and fertiliser manufacturing, minerals beneficiation and the like/. It could also provide a miscellany, albeit probably an incomplete one, of equipment common to all industries /the simpler electric motors, transformers, some switchgear, the simpler pumps, etc./.

Consider some examples.+

- Brazil can manufacture domestically all boilerwork up to 80 mm thickness, all the piping, joints and flanges, all the valves except some high-precision ball valves, most of the pumps up to flow ratings of 10 000 m^3/h at 6 to 7 bars to API chemical standard specifications, steam turbines up to 40 bars pressure, and a near-complete range of electricals /some variable-speed motors must be imported/. On the other hand, most of instrumentation has to be imported.
- India imported 100 % of process equipment, 96 % of structurals and 78 % of refractories for its first steel plant /Rourkela/. For the last one so far /Bokaro-Expansion/, the corresponding figures were 12, 0 and 0 %, respectively. For the Korba alumina plant, the tendering for which took place in 1969, imported process equipment /digester drives, pumps and pump drives/ made up about 5 % of total process equipment; for the Ratnagiri aluminium smelter /cancelled in the event/, it would have made up about 10 %. Indian companies can design and manufacture all

+ ID/WG.342/3, op. cit.

the boilerwork required for the industries considered here. Bharat Heavy Electricals of India is one of the top ten manufacturers of electrical equipment in the world: it can make 500 MW electricity generating sets and is tooling up for 1000 MW. 90 per cent of valves is produced domestically; so are pumps /although some are imported because of insufficient domestic capacity/, air and gas compressors; a cooperation agreement for gas turbines has been signed with Worthington of the US. India exhibited at the 1978 ACHEMA fair for capital goods in the chemical industry. It should be pointed out, however, that most Indian manufacturers have "technology maintenance" agreements with companies of developed market-economy countries /e.g. Bharat Heavy Electricals with Kraftwerk Union of the FRG/.

- In the Republic of Korea, all boilerwork up to 100 mm thickness and practically all the electrical equipment for chemical-industry projects can be made domestically. Blast furnaces, convertors and rolling mills, tanks, heat exchanger towers, compressors and filters etc. are being built at the Changwon industrial complex which at present can cover about 70 % of all Korean heavy industry project demand. Built on tidewater, it is export-orientated: in 1978, it exported more than one billion dollars worth out of a production worth $2.9 bn.

For examples of the second group of countries let us cite the following.

- Algeria is equiped to produce boilerwork, steel construction and structurals, and simpler machinery like speed reducers.
- Tunisia constructed by its own efforts the steel structures for a small iron and steel plant; it has set up

fairly complete maintenance facilities for its phosphate fertiliser industry; etc.

Let us point out that the importation of certain items does not imply of necessity that those cannot be built domestically. This was the case e.g. of the digester drives referred to in connection with the Korba alumina plant of India: Hungarian drives were imported because Hungarian industry was making those routinely while a prospective Indian manufacturer would have had to tool up from scratch.

What are the implications of all this?

/1/ There is considerable room for expansion of intra-South trade in capital goods. Let us recall that intra-South trade in engineering goods did, in current dollars, expand 15-fold between 1970 and 1980[+]/even though that was sufficient to raise its share of worldwide engineering goods trade from 0.5 to 1.4 % and its share of imports by the South from 2.2 to 4.7 % only; also, at a very rough estimate, it would have to grow by more than 23 % per year to attain 10 % of imports by the South by 1990 /assuming imports of engineering goods by the South to expand by 15 % per year from the developed market economies and by 10 % per year from the developed planned economies/, a development that is not at all unfeasible; to attain 20 %, however, it would have to grow by almost 35 % a year, which seems to be the outer bounds of the possible. Even assuming, which is certainly the case in some of the developing capital-goods producers, that there are considerable unutilised capacities in the engineering /and the capital/ goods sector, this is a far cry indeed from the South being able to satisfy the demands of a South de-linked from the North.

/2/ The bulk of capital goods produced by the first group of countries listed above would, in a de-linking situation, be consumed by itself and, in the second instance, by countries that are resources-rich and comparatively well-endowed with capital /the "high absorbers" of the OPEC group and some other countries/. The

[+] I.e. about 30 % per year.

bulk of the rest would be taken up by the second group of countries listed above. The capital goods demand of the remaining 100 or so countries /almost 150 if the countries and territories with less than one million inhabitants are also taken into consideration/ would be very greatly confined by lack of cash, of creditworthiness and of goods with which to pay for them.

/3/ In view of the evident hiatuses in the most developed Southern countries' engineering industries, outlined above, what would happen in a de-linking situation? Given the tremendous incentives that such a situation would offer to the said engineering industries, they would almost certainly muddle through, in the sense that they would find themselves able to construct workable complete plants for each of the industries considered here. /As shown above, they would certainly not be in a position to satisfy anything like the full demand of the South in the capital goods in question./ The underlying dialectic of the above assumption is that, the more de-linking there is, the less would the capital goods, the complete plant made in the South and the products thereof be competitive with those of the North; but then, the less would competitiveness with the North matter; the whole set of criteria of competition would be shifted so as to accommodate the goods that are in fact available.

/4/ In any other situation, the comparativ uation of developing-country suppliers will depend /a/ on lability from the North of consultancy services, the fr ongoing innovation and the most sophisticated items and components that go into complete plant; gradually reducing dependence as opposed to simply cutting loose will be the watchword here; /b/ on the supplier credit backing available in what can be expected to become a credit-terms competition among suppliers world-wide; in this the capital-surplus countries of the South, if any, may contribute usefully to both the suppliers and themselves.

G.6 Impact on the North

The thing to be remembered here that world trade is overwhelmingly intra-North. At any time when the world economy would function normally, the North would take in its stride the small shifts in trade that a gradual delinking would entail. But times today are /let us hope/ non-normal. At a time of deep recession, any downward pressure on capacity utilisation is a bad thing. True, enhanced economic growth in the South resulting from enhanced intra-South cooperation is likely to boost trade with the North in the longer or perhaps the medium term; but immediate consequences will be not that favourable, especially for the industries such as petroleum refining, petrochemicals making and some forms of metallurgy /aluminium, tin/ that are liable to be squeezed by the developments in the South. It would therefore be wrong to submit that, at the present time, an enhanced South-South cooperation would bring nothing but benefits to the North.

The flows of raw materials/minerals-based commodities from the South to the North would not be upset by enhanced South-South cooperation: in fact, they are more likely to increase.

Delinking in turn would probably be the worst thing that could happen to both groups of countries, although it might alleviate the debt burdens of the greatest debtor countries. It would entail the necessity of completely restructuring the trade patterns of minerals and minerals-based commodities, including the underutilisation of the capacities having the greatest comparative advantage and the development of indifferent or indeed poor-grade deposits and indifferent or unsuitable sites.

The only scenario which is likely to considerably benefit both groups of countries taken as a whole, and a maximum number of individual countries within each, is enhanced NN-SS cooperation. It would permit to reflate out of a world recession in the Keynesian spirit. The problem is that such a reflation would have to be financed jointly by the North and the capital-surplus South. Such joint financing would require the clearing away of a great deal of mutual suspicion, the creation of a spirit - let us not hesitate to call it that - enlightened progressism. Another important point is that, precisely because of that atmosphere, a strong resolve must be maintained not to let such financing degenerate into a club of the moneyed. into a joining-by-accretion of the North by the capital-surplus and the most developed South. The benefits of world Keynesian stimulation must be shared by all if that stimulation is to be at its most efficacious.

G.7. UNIDO's role

/a/ Studies. Points on which further thought or further collection of information is required include

- at the purely technical level, into economically viable mini-plants permitting developing countries or subregional groupings to make their own mineral resource-based commodities without incurring excess costs due to diseconomies of scale; especially in fertilisers, but also in petrochemicals;
- probably in combination with ILO, into South-South movements of labour,
- ditto, into the issues and into the possible ways and means of expanding training for Southern nationals in Southern countries not their own;
- probably in combination with UNCTAD, into the philosophy of splitting the increased benefits of South-South cooperation between the parties involved.

/b/ Institutional. To initiate the organisation of consultative bodies preparing the setting up, largely profiting by the experience of the comparable fertiliser bodies, associations of developing-country producers and would-be producers in petroleum refining, basic petrochemicals or petrochemicals at large, and metallurgy.

To set up a body sponsoring and supervising the training of labour for these industries in the South, no matter whether at home or abroad, such sponsoring and supervision to be tantamount to a mark of quality, on the principle of the UNESCO-associated schools of general learning; possibly in cooperation with ILO.

To look into the availability of non-commercial systems consultancy services such as the one the idea of which ahas been mooted by the Socialist International, and to set up a general clearing-house of such services.

To set up, probably in cooperation with DTCD and UNRFNRE, a consultative body looking into the feasibility of industry-orientated regional mineral resource exploration anddedevelopment bodies /potash reserves could be a first priority for such exploration/.

APPENDIX I

Reserve situation in steel alloying elements

Tables

Table App. I/1

World cobalt reserves and resources, thousand tons

Resources inclusive of reserves

Region	Reserves		Resources	
	tons	%	tons	%
1 NA	27.2	1.1	1025.1	18.9
2 WE	18.1	0.7	22.7	0.4
3 EE	226.8	9.4	249.5	4.6
4 JP	-	-	-	-
5 OD	68.1	2.8	322.0	5.9
6 LA	181.4	7.5	1134.0	20.8
7 TA	1569.4	65.1	2027.6	37.3
8 NE	45.4	1.9	68.0	1.2
9 IN	-	-	-	-
10 AS	272.1	11.3	589.7	10.8
11 OA	-	-	-	-
Total	2408.5	100.0	5438.6	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

Table App.I/2

World cobalt mine and primary refined metal and chemical compound production, 1978; mine production capacity, 1978 and 1985

Region	Cobalt mine production 1978		Primary refined metal and chem. compound prod., 1978		Cobalt mine capacity 1978		Cobalt mine capacity 1985	
	tons	%	tons	%	tons	%	tons	%
1 NA	1233,8	4.9	811.0	3.6	1633.0	5.7	2268.0	5.9
2 WE	1296,4	5.1	3121.6	13.9	1315.4	4.6	1587.6	4.2
3 EE	1950,5	7.7	1950.5	8.7	1995.8	7.0	2041.2	5.3
4 JP	-	-	1864.3	8.3	-	-	-	-
5 OD	1451.5	5.8	-	-	1451.5	5.1	2041.2	5.4
6 LA	1633.0	6.4	-	-	1633.0	5.7	1814.4	4.8
7 TA	15294.6	60.3	14691.2	65.5	17962.6	62.7	24948.0	65.5
8 NE	1134.0	4.5	-	-	1134.0	4.0	1134.0	2.9
9 IN	-	-	-	-	-	-	-	-
10 AS	1345.4	5.3	-	-	1496.9	5.2	2268.0	5.9
11 OA	-	-	-	-	-	-	-	-
Total	25339.2	100.0	22438.6	100.0	28622.2	100.0	38102.4	100.0

Remark. Mine production refers to estimated recovered cobalt content. Primary refined etc. refers to estimated contained cobalt. Percentages may not add up owing to rounding.

Source: Mineral Facts and Problems, op. cit.

Table App. I/3

World manganese reserves and resources, million tons

Resources inclusive of reserves

Region	Reserves		Resources	
	million tons	%	million tons	%
1 NA	-	-	82.7	3.0
2 WE	0.2	0.0	0.2	0.0
3 EE	352.4	26.2	896.7	32.2
4 JP	0.6	0.0	0.6	0.0
5 OD	834.6	61.9	1555.8	55.9
6 LA	44.1	3.3	83.6	3.0
7 TA	83.4	6.2	103.9	3.7
8 NE	0.4	0.0	0.4	0.0
9 IN	19.5	1.4	30.4	1.1
10 AS	0.5	0.0	3.4	0.1
11 OA	13.6	1.0	29.0	1.0
Total	1349.3	100.0	2486.7	100.0

Source: Mineral Facts and Problems, op. cit.

Table App. I/4

World manganese production, 1978, and capacity, 1978, 1979, and 1985, thousand tons of manganese content

Region	Production in 1978		Capacity 1978		Capacity 1979		Capacity 1985	
	000 t	%	000 t	%	000 t	%	000 t	%
1 NA	34.5	0.4	45.4	0.4	45.4	0.4	45.4	0.4
2 WE	-	-	-	-	-	-	-	-
3 EE	3229.6	37.2	3515.3	31.2	3510.8	31.2	3850.9	31.7
4 JP	29.9	0.3	31.8	0.3	27.2	0.2	27.2	0.2
5 OD	2364.1	27.1	3547.0	31.6	3547.0	31.6	4000.6	33.0
6 LA	1007.0	11.6	1442.4	12.8	1442.4	12.8	1542.2	12.7
7 TA	973.4	11.2	1406.1	12.5	1360.7	12.1	1496.9	12.3
8 NE	67.1	0.8	77.1	0.7	77.1	0.7	27.2	0.2
9 IN+	548.8	6.3	725.7	6.4	725.7	6.4	635.0	5.2
10 AS	57.2	0.7	63.3	0.5	63.5	0.5	49.9	0.4
11 OA+	381.0	4.4	399.2	3.5	453.6	4.0	453.6	3.7
Total	8692.6	100.0	11253.5	100.0	11253.4	100.0	12128.9	100.0

+ The Indian and Chinese figures include manganese in manganiferous ore.

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding.

Table App. I/5

World nickel reserves and resources, million tons

Resources inclusive of reserves

Region	Reserves million tons	Reserves %	Resources million tons	Resources %
1 NA	82.2	15.2	331.1	16.0
2 WE	-	-	-	-
3 EE	73.5	13.6	193.2	9.3
4 JP	-	-	-	-
5 OD	50.8	9.4	79.8	3.9
6 LA	55.9	10.3	246.8	11.9
7 TA+	20.9	3.9	81.6	3.9
8 NE	-	-	-	-
9 IN	-	-	-	-
10 AS	258.5	47.7	1134.9	54.9
11 OA	-	-	-	-
Totals	541.8	100.0	2067.4	100.0

Source: Mineral Facts and Problems, op. cit.

Remark: Percentages may not add up owing to rounding

\+ Includes, in this case, South Africa and Africa North of the Sahara

Table App. I/6

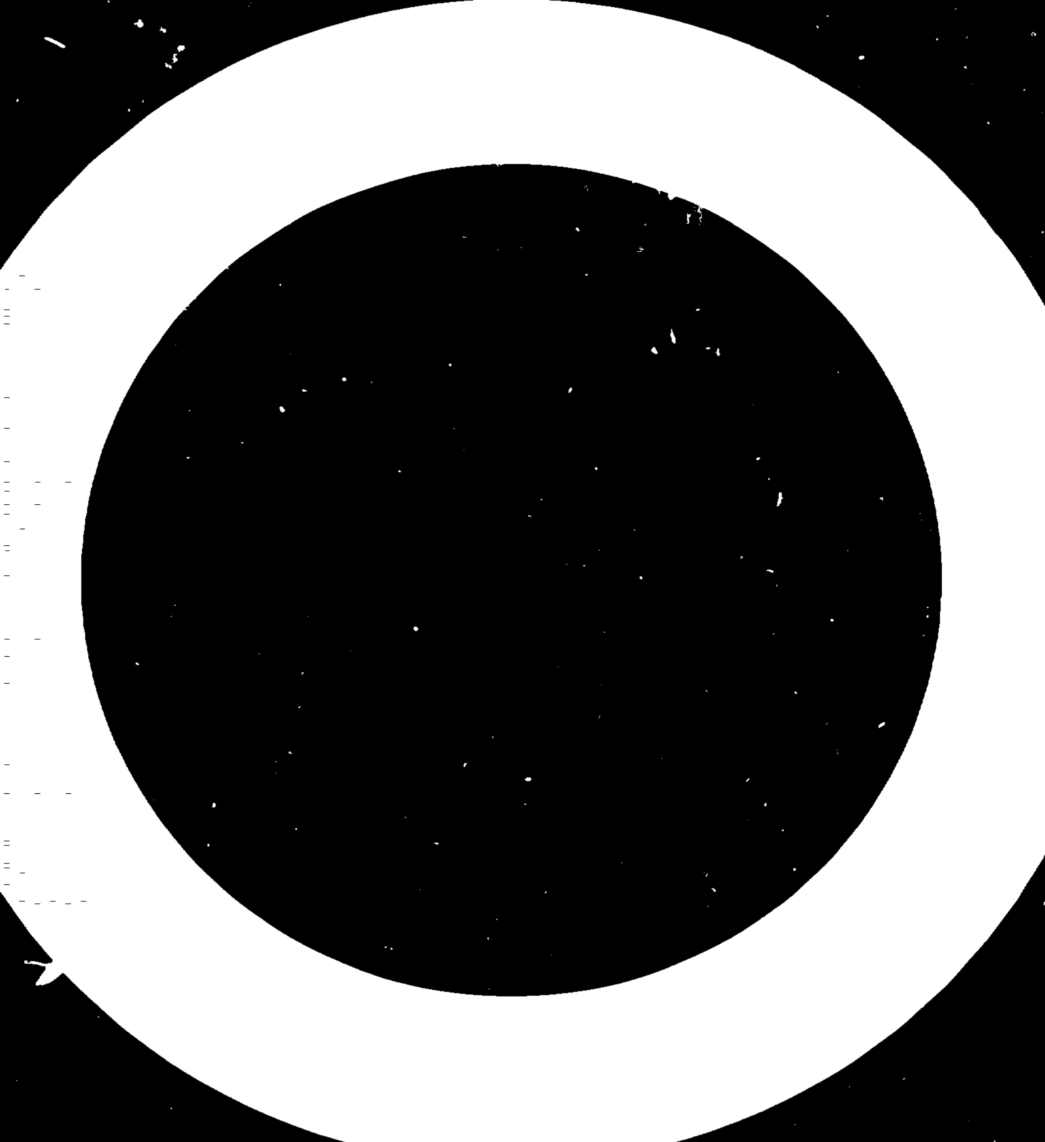
World nickel mine production, 1978, and capacity, 1978 and 1985

thousand tons

Region		Production in 1978		Capacity 1978		Capacity 1985	
		000 t	%	000 t	%	000 t	%
1	NA	1403	21.2	2658	28.4	2639	21.9
2	WE	301	4.5	680	7.3	1043	8.7
3	EE	1587	24.0	1669	17.8	2214	18.4
4	JP	-	-	-	-	-	-
5	OD	1044	15.8	1089	11.6	1297	10.8
6	LA	568	8.6	865	9.2	1388	11.5
7	TA+	321	4.9	362	3.9	1381	3.2
8	NE	1	0.0	60	0.6	200	1.7
9	IN	-	-	-	-	-	-
10	AS	1291	19.5	1868	20.0	2684	22.3
11	OA	100	1.5	109	1.2	181	1.5
Totals		6616	100.0	9360	100.0	12047	100.0

+ Includes, in this case, South Africa and Africa North of the Sahara

Source: Mineral Facts and Problems, op. cit.



APPENDIX II

Information on basic petrochemicals development up to 1990

Source: UNIDO: Second World-wide Study on the Petrochemical Industry: Process of Restructuring, ID/WG. 336/3. 20 May 1981.

Growth of the petrochemical industry in developing countries: 1975 - 1990

Capacity to produce basic petrochemicals

The petrochemical industry in developing countries is growing by 15 per cent per year. The progress is best measured by their plans to establish plants to manufacture basic petrochemicals. As of April 1981, 27 developing countries had announced plans to establish ethylene plants compared to the 13 plants in existence in 1979; of those 27 producers, 16 will also produce propylene and 11 will produce butadiene. The new ethylene producing countries are Qatar, Libya and Singapore in the period up to 1984; after 1984, the new producers are to be found in Africa (Egypt, Nigeria), Middle East (Kuwait and Saudi Arabia), Asia (Iran, Indonesia, Pakistan and Philippines) and in Latin America (Bolivia, Ecuador and Peru). Capacity in developing countries to produce the three olefins (ethylene, propylene and butadiene) is estimated to increase eight-fold in the period 1975 to 1987, with the biggest increase in capacity coming after 1984.

Developing countries' capacity to produce olefins
(million tons)

Capacity at years end	Ethylene	Propylene	Butadiene
1975	1.40	0.74	0.28
1979	3.38	1.52	0.54
1984 1/	7.90	3.05	1.04
1987 1/	14.50	4.36	1.38

1/ Based on plans reported as of April 1981.

A total of 17 developing countries have made plans to establish plants to manufacture aromatics (benzene, xylenes, toluene) compared to plants in existence in 8 countries at the end of 1979.
The other basic petrochemical considered in this study - methanol - was produced in only 8 developing countries in 1979; but there will be 16 producing countries by 1987. Aromatics are generally required in smaller quantities; but since aromatics can be produced by modifying petroleum refineries, many other developing countries are expected to

Production capacity of 30 developing countries in three basic petrochemicals (olefins)
(thousand metric tons)

	Ethylene			Propylene			Butadiene		
	1979	1984	1987	1979	1984	1987	1979	1984	1987
AFRICA									
Nigeria	-	-	280	-	35	35	-	-	-
N. AFRICA									
Algeria	120	120	120	-	-	-	-	-	-
Egypt	-	-	140	-	-	-	-	-	-
Libya	-	330	330	-	50	50	-	60	60
Morocco	-	-	-	-	-	-	-	-	-
W. ASIA									
Bahrain	-	-	-	-	-	-	-	-	-
Iraq	30	160	160	-	-	-	-	-	-
Kuwait	-	-	300	-	-	-	-	-	-
Qatar	-	280	280	-	-	-	-	-	-
Saudi Arabia	-	-	1600	-	-	-	-	-	-
Turkey	60	360	360	40	100	100	30	30	30
U. Arab Emirates	-	-	-	-	-	-	-	-	-
ASIA									
India	240	240	920	120	120	220	50	50	70
Indonesia	-	-	350	-	-	-	-	-	-
Iran	30	30	300	15	15	125	-	-	25
Malaysia	-	-	-	-	-	-	-	-	-
Pakistan	-	-	100	-	-	-	-	-	-
Phillipines	-	-	250	-	-	-	-	-	-
Rep. of Korea	150	850	1200	80	450	630	25	125	175
Singapore	-	300	300	-	165	165	-	-	-
Thailand	-	-	150	-	-	-	-	-	-
Other Asia	570	920	920	290	410	410	80	120	120
CHINA	540	950	1810	230	410	950	100	130	220
LATIN AMERICA									
Argentina	170	250	550	80	100	240	40	40	120
Bolivia	-	-	160	-	-	80	-	-	-
Brazil	740	1220	1220	410	650	650	170	240	240
Chile	60	180	180	-	-	-	-	-	-
Columbia	20	120	120	10	10	10	-	-	-
Ecuador	-	-	100	-	-	-	-	-	-
Mexico	440	1440	1940	150	450	450	150	150	250
Peru	-	-	250	-	-	150	-	-	70
Venezuela	150	150	500	90	90	90	-	-	-

Production capacity of 33 developing countries in three basic petrochemicals (aromatics and methanol) (thousand metric tons)

	XYLENES 1/			BENZENE			METHANOL		
	1979	1984	1987	1979	1984	1987	1979	1984	1987
AFRICA									
Nigeria	-	-	-	-	20	20	-	-	-
N. AFRICA									
Algeria	-	40	40	-	-	-	110	110	110
Egypt	-	-	-	-	-	-	-	-	-
Libya	-	-	-	-	-	-	330	330	330
W. ASIA									
Bahrain	-	-	-	-	-	-	-	330	330
Iraq	-	-	-	-	-	-	-	330	330
Kuwait	-	-	140	-	-	280	-	-	-
Qatar	-	-	-	-	-	-	-	-	-
Saudi Arabia	-	-	-	-	-	-	-	-	1400
Turkey	-	200	200	-	150	150	-	100	100
U. Arab Emirates	-	-	-	-	-	-	-	-	-
ASIA									
India	40	100	160	150	210	310	-	60	60
Indonesia	-	-	240	-	-	370	-	-	330
Iran	-	-	120	-	-	350	-	-	100
Malaysia	-	-	-	-	-	-	-	-	330
Pakistan	40	40	40	-	-	-	-	-	-
Phillipines	-	-	-	-	-	-	-	-	-
Rep. of Korea	50	400	400	110	250	250	390	390	390
Singapore	-	-	-	-	-	-	-	-	-
Thailand	-	-	-	-	-	-	-	-	-
Other Asia	260	400	400	200	340	440	120	190	190
CHINA	30	210	400	400	500	800	260	400	800
LATIN AMERICA									
Argentina	65	65	65	230	230	290	40	40	40
Bolivia	-	-	-	-	-	100	-	-	-
Brazil	160	230	230	270	390	390	140	140	140
Chile	-	-	-	-	-	-	-	-	-
Colombia	60	60	210	40	40	90	-	-	-
Ecuador	-	-	70	-	-	140	-	-	-
Mexico	110	410	710	120	720	720	180	1000	1820
Peru	-	-	20	-	-	120	-	-	-
Venezuela	-	-	50	-	-	100	-	-	330

1/ Para-Xylene and Ortho-Xylene

become producers by 1990. Capacity to produce benzene and xylenes in developing countries is estimated to increase six-fold between 1975 and 1987 and methanol by 5 times between 1979 and 1987

Developing countries' capacity to produce aromatics and methanol (million metric tons)

Capacity at years end	Benzene	Xylenes 1/	Methanol
1975	1.05	0.21	0.27
1979	1.60	1.03	1.40
1984	3.15	2.29	3.35
1987	4.92	3.09	6.80

1/ Para-xylene and ortho-xylene.

Demand for the most important 5 basic petrochemicals is expected to increase ten-fold from 2.8 million tons in 1975 to 28 million tons in 1990. The contribution of each region to demand is summarized below.

Demand for basic petrochemicals in developing countries in 1975 and 1990 (million tons)

Regions	Ethylene		Propylene		Butadiene		Xylenes		Benzene	
	1975	1990	1975	1990	1975	1990	1975	1990	1975	1990
Africa	-	0.30	-	0.06	-	0.06	-	0.10	-	0.05
N. Africa	-	0.80	-	0.10	-	0.05	-	0.10	-	0.05
W. Asia	-	2.65	-	0.16	0.01	0.06	-	0.30	0.02	0.15
Asia	0.25	3.80	0.20	1.80	0.08	0.50	0.05	1.20	0.20	1.60
China	0.30	1.40	0.07	0.85	0.04	0.33	-	0.30	0.28	1.40
Latin America	0.60	5.00	0.20	1.50	0.08	0.60	0.15	1.00	0.30	1.75
TOTAL	1.15	13.95	0.47	4.47	0.21	1.60	0.20	3.00	0.80	5.00

Estimated annual rate of growth of demand for basic petrochemicals in developing countries (per cent per annum)

	1975-79	1979-84	1984-1990
Ethylene	24.0	17.6	14.9
Propylene	26.0	15.1	10.8
Butadiene	14.7	10.0	8.7
Benzene	12.8	15.6	10.8
Xylene	41.4	17.6	8.8

Growth of demand for selected petrochemical products (per cent per annum)

Petrochemical Product	World Total			Industrialized Countries			Developing Countries		
	1975 -1979	1979 -1984	1984 -1990	1975 -1979	1979 -1984	1984 -1990	1975 -1979	1979 -1984	1984 -1990
Basic Petrochemicals									
Ethylene	11.2	6.2	6.0	10.4	5.8	4.3	24.0	17.6	14.9
Propylene	11.8	5.2	6.4	8.7	4.4	5.9	26.0	15.1	10.8
Butadiene	8.8	5.0	4.6	7.8	3.7	3.6	18.9	16.4	10.0
Benzene	11.0	5.7	4.9	10.8	4.7	4.0	12.8	15.6	10.8
Xylenes	11.8	7.1	5.6	9.3	5.1	4.5	41.4	17.6	8.8
Methanol	10.7	9.5	7.0	10.1	11.4	6.3	22.9	17.6	12.0

Demand for basic petrochemicals

The rate of growth of demand for basic petrochemicals was summarized in Table I.18 on page 18 above. Estimates of the demand for five basic petrochemicals in 1975 and 1990 in industrialized countries are summarized , below.

Demand for basic petrochemicals in industrialized countries
in 1975 and 1990
(million tons)

Region	Ethylene		Propylene		Butadiene		Benzene		Xylene	
	1975	1990	1975	1990	1975	1990	1975	1990	1975	1990
Japan	3.40	6.20	2.30	3.30	0.47	0.80	1.48	2.50	0.65	1.14
W. Europe	7.90	16.60	4.10	10.00	0.81	1.65	3.26	7.00	1.09	2.04
N. America	9.80	23.60	4.40	15.00	1.50	2.50	3.74	10.00	1.32	3.32
USSR and Eastern Europe	2.00	8.60	1.20	3.50	0.45	1.50	2.15	6.00	0.60	2.25
Other Countries	0.25	1.50	0.12	0.60	0.10	0.25	0.08	0.30	0.02	0.10
TOTAL	23.35	56.50	12.12	32.40	3.33	6.70	10.71	25.80	3.68	8.85

Demand for Methanol

Demand for methanol is difficult to forecast because new end uses are expected to become increasingly important in the 1980s. Demand for methanol in industrialized countries is expected to increase 50% between 1979 and 1984 and a further 50% between 1984 and 1990, that is from about 11 million tons in 1979 to 16 million tons in 1984 and 24 million tons in 1990. However, the estimates for 1990 could be much too low if methanol begins to be used as a fuel in power stations and it is used in gasoline blending on a larger scale than forecast below in Table I.26, which estimates the expected pattern of demand in 1985 and 1990 in Western Europe, United States and Japan.

Estimates of capacity to produce selected petrochemicals in industrialized countries (million tons)

Petrochemical Products	Japan 1979	Japan 1984	W. Europe 1979	W. Europe 1984	N. America 1979	N. America 1984	USSR + E. Europe 1979	USSR + E. Europe 1984	Other Countries 1979	Other Countries 1984	Total 1979	Total 1984
Basic Petrochemicals												
Ethylene	6.00	6.00	14.70	17.60	18.00	22.2	3.90	6.50	0.60	1.00	43.20	53.30
Propylene	4.30	4.30	8.10	9.70	10.00	12.90	2.00	3.00	0.28	0.41	24.68	30.31
Butadiene	0.80	0.80	2.13	2.25	2.40	2.60	0.50	1.00	0.12	0.12	5.95	6.77
Benzene	3.00	3.00	6.60	7.20	8.60	9.60	3.30	5.00	0.20	0.30	21.70	25.10
Xylenes	1.11	1.11	1.98	2.11	3.05	3.25	0.90	1.70	0.04	0.09	7.10	8.26
Methanol	1.30	1.30	3.70	5.00	4.15	8.00	3.00	4.85	0.12	1.35	12.28	20.50

Additions to capacity to produce methanol (thousand tons)

	1979 - 1984	After 1984
Japan	-	-
Western Europe	1,300	2,000
North America		
United States	2,400	
Canada	1,500	700
U.S.S.R. and Eastern Europe		
U.S.S.R.	1,650	
Eastern Europe	200	
New Zealand	400	
South Africa	825	
Total industrialized countries	8,275	2,700

Share of developed and developing countries in the increase in world demand for selected petrochemicals

Petrochemical Products	Increase in Demand 1979-1990			Share of Increase 1979-1990	
	World Total	Developed Countries (million tons)	Developing Countries	Developed Countries per cent	Developing Countries
Basic Petrochemicals					
Ethylene	33.0	21.8	11.2	66	34
Propylene	17.3	14.0	3.3	81	19
Butadiene	3.4	2.2	1.2	65	35
Benzene	13.3	9.6	3.7	72	28
Xylenes	5.8	3.6	2.2	62	38
Methanol	16.0	13.2	2.8	82	18

Increased exports from developing countries

International trade between developing and industrialized countries is likely to become better balanced in the late 1980s when developing countries bring on stream the 11 expcrt-oriented petrochemical plants or complexes producing ethylene derivatives, propylene derivatives, benzene, xylenes and methanol listed on the following page.

Capacity of export-oriented plants planned by
developing countries
(million tons)

COUNTRY	DATE	ETHYLENE	PROPYLENE	BENZENE	XYLENES	METHANOL
Libya	1979	-	-	-	-	330
Qatar	1980	280	-	-	-	330
Libya	1984	330	50	-	-	330
Bahrain	1984	-	-	-	-	330
Singapore	1984	300	165	-	-	-
Kuwait	1985	300		280	140	-
Saudi Arabia	1985-86	1600	-	-	-	1400
TOTAL		2810	215	280	140	2720

In addition to these plants, Iraq, Iran, Indonesia, Republic of Korea , another Asian country , Brazil, Mexico and Venezuela are likely to have significant quantities of production available for export, at least for some years after a large new complex has come on stream.

There should be no difficulty in absorbing the petrochemicals made available by these developing countries for export in the period up to 1990. The world market for each product is growing and the quantities available for export amount to a small share of the increase in demand, except for ethylene (12 per cent) and methanol (27 per cent). Further more, some old plants in developed countries will need to be replaced by new capacities.

World market for exports from
developing countries 1984-1990
(million tons)

Products	Increase in Demand 1984-1990			Supply available from planned export-oriented plants in developing countries after 1984	
	Industrialized Countries	Developing Countries	World Total	Minimum	Maximum
Ethylene and derivatives	13.0	7.8	20.8	2.5	3.5
Propylene and derivatives	9.5	2.0	11.5	0.15	0.25
Benzene	5.4	2.3	7.7	0.25	0.35
Xylene	2.0	1.2	3.2	0.10	0.20
Methanol	7.4	1.7	9.1	2.5	3.3

Indeed, given growth in the market and the need to replace plants, there appears to be scope to establish a greater number of export-oriented plants in the period 1986-1990 in developing countries. It appears that more attantion could be given to producing the other olefins (propylene and butadiene) and aromatics as well as those products most frequently chosen so far. The products may then be exported as basic petrochemicals or as intermediates or final products.

The developing countries will need to continue importing many petrochemicals as well as special grades of some products they produce themselves. Therefore, interdependence will mean not so much a reduction in their imports from industrialized countries but rather a more balanced trade in which the developing countries export petrochemicals to the industrialized countries on a substantial scale for the first time.

There will also be a trend for the more advanced petrochemical producers in developing countries to replace industrialized countries as suppliers of importing developing countries. In 1979, industrialized countries supplied 2.8 million tons of thermoplastics, 700,000 tons of synthetic fibres and 900,000 tons of synthetic fibre intermediates and 300,000 tons of synthetic rubbers to the developing countries. Some countries in Asia and Latin America have already begun to replace traditional suppliers with their own exports and this trend should accelerate in the 1980s.